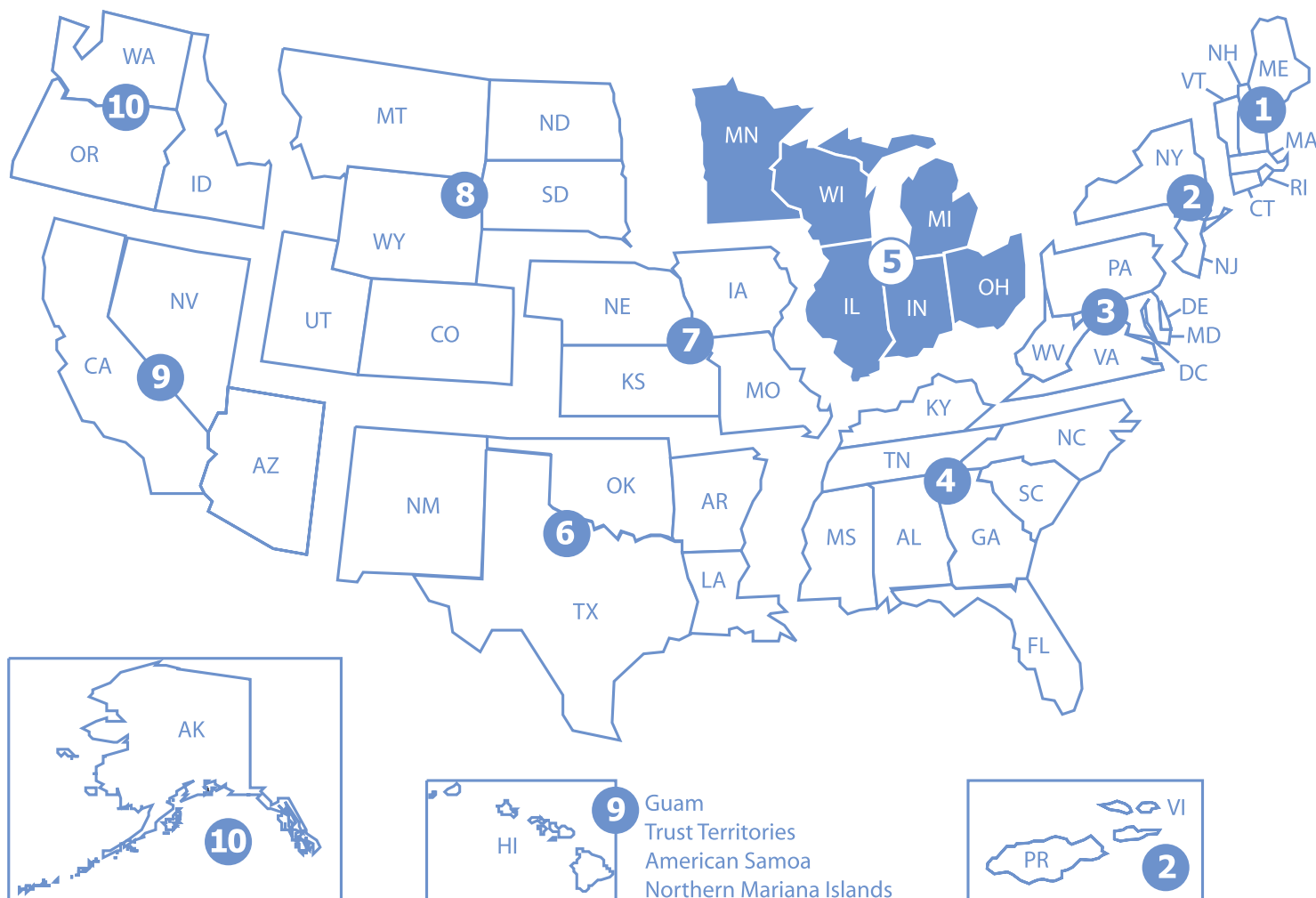




Support Document for the Revised National Priorities List Final Rule – Beck's Lake



**Support Document for the
Revised National Priorities List
Final Rule
Beck's Lake
December 2013**

**Site Assessment and Remedy Decisions Branch
Office of Superfund Remediation and Technology Innovation
Office of Solid Waste and Emergency Response
U.S. Environmental Protection Agency
Washington, DC 20460**

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Attachment 1 –Documentation of AMEC Freedom of Information Act (FOIA) request

Attachment 2 - *Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States*, U. S. Geological Survey Professional Paper 1270, Shacklette and Boerngen, 1984

Executive Summary

Section 105(a)(8)(B) of CERCLA, as amended by SARA, requires that the EPA prepare a list of national priorities among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States. An original National Priorities List (NPL) was promulgated on September 8, 1983 (48 FR 40658). CERCLA requires that EPA update the list at least annually.

This document provides responses to public comments received on the Beck's Lake site, proposed on May 24, 2013 (78 FR 31464). This site is being added to the NPL based on an evaluation under EPA's Hazard Ranking System (HRS) in a final rule published in the *Federal Register* in December 2013.

Introduction

This document explains the rationale for adding the Beck's Lake site in South Bend, Indiana to the National Priorities List (NPL) of uncontrolled hazardous waste sites and provides responses to public comments received on this site listing proposal. The EPA proposed this site to the NPL on May 24, 2013 (78 FR 31464). This site is being added to the NPL based on an evaluation under the Hazard Ranking System (HRS) in a final rule published in the *Federal Register* in December 2013.

Background of the NPL

In 1980, Congress enacted the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. Sections 9601 *et seq.* in response to the dangers of uncontrolled hazardous waste sites. CERCLA was amended on October 17, 1986, by the Superfund Amendments and Reauthorization Act (SARA), Public Law No. 99-499, stat., 1613 *et seq.* To implement CERCLA, EPA promulgated the revised National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR Part 300, on July 16, 1982 (47 FR 31180), pursuant to CERCLA Section 105 and Executive Order 12316 (46 FR 42237, August 20, 1981). The NCP, further revised by EPA on September 16, 1985 (50 FR 37624) and November 20, 1985 (50 FR 47912), sets forth guidelines and procedures needed to respond under CERCLA to releases and threatened releases of hazardous substances, pollutants, or contaminants. On March 8, 1990 (55 FR 8666), EPA further revised the NCP in response to SARA.

Section 105(a)(8)(A) of CERCLA, as amended by SARA, requires that the NCP include

criteria for determining priorities among releases or threatened releases throughout the United States for the purpose of taking remedial action and, to the extent practicable, take into account the potential urgency of such action, for the purpose of taking removal action.

Removal action involves cleanup or other actions that are taken in response to emergency conditions or on a short-term or temporary basis (CERCLA Section 101). Remedial action is generally long-term in nature and involves response actions that are consistent with a permanent remedy for a release (CERCLA Section 101). Criteria for placing sites on the NPL, which makes them eligible for remedial actions financed by the Trust Fund established under CERCLA, were included in the HRS. EPA promulgated the HRS as Appendix A of the NCP (47 FR 31219, July 16, 1982). On December 14, 1990 (56 FR 51532), EPA promulgated revisions to the HRS in response to SARA, and established the effective date for the HRS revisions as March 15, 1991.

Section 105(a)(8)(B) of CERCLA, as amended, requires that the statutory criteria provided by the HRS be used to prepare a list of national priorities among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States. The list, which is Appendix B of the NCP, is the NPL.

An original NPL of 406 sites was promulgated on September 8, 1983 (48 FR 40658). At that time, an HRS score of 28.5 was established as the cutoff for listing because it yielded an initial NPL of at least 400 sites, as suggested by CERCLA. The NPL has been expanded several times since then, most recently on May 24, 2013 (78 FR 31417). The Agency also has published a number of proposed rulemakings to add sites to the NPL. The most recent proposal was on May 24, 2013 (78 FR 31464).

Development of the NPL

The primary purpose of the NPL is stated in the legislative history of CERCLA (Report of the Committee on Environment and Public Works, Senate Report No. 96-848, 96th Cong., 2d Sess. 60 [1980]).

The priority list serves primarily informational purposes, identifying for the States and the public those facilities and sites or other releases which appear to warrant remedial actions. Inclusion of a facility or site on the list does not in itself reflect a judgment of the activities of its owner or operator, it does not require those persons to undertake any action, nor does it assign liability to any person. Subsequent government actions will be necessary in order to do so, and these actions will be attended by all appropriate procedural safeguards.

The NPL, therefore, is primarily an informational and management tool. The identification of a site for the NPL is intended primarily to guide EPA in determining which sites warrant further investigation to assess the nature and extent of the human health and environmental risks associated with the site and to determine what CERCLA-financed remedial action(s), if any, may be appropriate. The NPL also serves to notify the public of sites EPA believes warrant further investigation. Finally, listing a site may, to the extent potentially responsible parties are identifiable at the time of listing, serve as notice to such parties that the Agency may initiate CERCLA-financed remedial action.

CERCLA Section 105(a)(8)(B) directs EPA to list priority sites among the known releases or threatened release of hazardous substances, pollutants, or contaminants, and Section 105(a)(8)(A) directs EPA to consider certain enumerated and other appropriate factors in doing so. Thus, as a matter of policy, EPA has the discretion not to use CERCLA to respond to certain types of releases. Where other authorities exist, placing sites on the NPL for possible remedial action under CERCLA may not be appropriate. Therefore, EPA has chosen not to place certain types of sites on the NPL even though CERCLA does not exclude such action. If, however, the Agency later determines that sites not listed as a matter of policy are not being properly responded to, the Agency may consider placing them on the NPL.

Hazard Ranking System

The HRS is the principle mechanism EPA uses to place uncontrolled waste sites on the NPL. It is a numerically based screening system that uses information from initial, limited investigations -- the preliminary assessment and site inspection -- to assess the relative potential of sites to pose a threat to human health or the environment. HRS scores, however, do not determine the sequence in which EPA funds remedial response actions, because the information collected to develop HRS scores is not sufficient in itself to determine either the extent of contamination or the appropriate response for a particular site. Moreover, the sites with the highest scores do not necessarily come to the Agency's attention first, so that addressing sites strictly on the basis of ranking would in some cases require stopping work at sites where it was already underway. Thus, EPA relies on further, more detailed studies in the remedial investigation/feasibility study that typically follows listing.

The HRS uses a structured value analysis approach to scoring sites. This approach assigns numerical values to factors that relate to or indicate risk, based on conditions at the site. The factors are grouped into three categories. Each category has a maximum value. The categories are:

- likelihood that a site has released or has the potential to release hazardous substances into the environment;
- characteristics of the waste (e.g., toxicity and waste quantity); and
- targets (e.g., people or sensitive environments) affected by the release.

Under the HRS, four pathways can be scored for one or more threats as identified below:

- Ground Water Migration (S_{gw})

- Surface Water Migration (S_{sw})
The following threats are evaluated for two separate migration components, overland/flood migration and ground water to surface water.
 - drinking water
 - human food chain
 - sensitive environments
- Soil Exposure (S_s)
 - resident population
 - nearby population
- Air Migration (S_a)
 - population

After scores are calculated for one or more pathways according to prescribed guidelines, they are combined using the following root-mean-square equation to determine the overall site score (S), which ranges from 0 to 100:

$$S = \sqrt{S_{gw}^2 + S_{sw}^2 + S_s^2 + S_a^2}$$

If all pathway scores are low, the HRS score is low. However, the HRS score can be relatively high even if only one pathway score is high. This is an important requirement for HRS scoring because some extremely dangerous sites pose threats through only one pathway. For example, buried leaking drums of hazardous substances can contaminate drinking water wells, but -- if the drums are buried deep enough and the substances not very volatile -- not surface water or air.

Other Mechanisms for Listing

There are two mechanisms other than the HRS by which sites can be placed on the NPL. The first of these mechanisms, authorized by the NCP at 40 CFR 300.425(c)(2), allows each State and Territory to designate one site as its highest priority regardless of score. The last mechanism, authorized by the NCP at 40 CFR 300.425(c)(3), allows listing a site if it meets the following three requirements:

- Agency for Toxic Substances and Disease Registry (ATSDR) of the U.S. Public Health Service has issued a health advisory that recommends dissociation of individuals from the release;
- EPA determines the site poses a significant threat to public health; and
- EPA anticipates it will be more cost-effective to use its remedial authority than to use its emergency removal authority to respond to the site.

Organization of this Document

The following section contains EPA responses to site-specific public comments received on the proposal of the Beck's Lake site on May 24, 2013 (78 FR 31464). The site discussion begins with a list of commenters, followed by a site description, a summary of comments, and Agency responses to each comment. A concluding statement indicates the effect of the comments on the HRS score for the site.

Glossary

The following acronyms and abbreviations are used throughout the text:

Agency	U.S. Environmental Protection Agency
AMEC	AMEC Environment & Infrastructure, Inc.
AOC	Area of Observed Contamination
APA	Administrative Procedure Act
ATSDR	Agency for Toxic Substances and Disease Registry
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. Sections 9601 <i>et seq.</i> , also known as Superfund
CFR	Code of Federal Regulations
EPA	U.S. Environmental Protection Agency
ESI	Expanded Site Inspection
FOIA	Freedom of Information Act
FR	Federal Register
HRS	Hazard Ranking System, Appendix A of the NCP
HRS score	Overall site score calculated using the Hazard Ranking System; ranges from 0 to 100
IDEM	Indiana Department of Environmental Management
mg/kg	Milligram per kilogram
NCP	National Oil and Hazardous Substances Pollution Contingency Plan, 40 C.F.R. Part 300
NPL	National Priorities List, Appendix B of the NCP
PPM	Parts per million
PA/SI	Preliminary Assessment and Site Inspection
RI	Remedial Investigation
SARA	Superfund Amendments and Reauthorization Act
USGS	United States Geological Survey

1. List of Commenters and Correspondence

EPA-HQ-SFUND-2013-0196-0004	Correspondence, dated February 1, 2012, from Thomas W. Easterly, Commissioner, Indiana Department of Environmental Management
EPA-HQ-SFUND-2013-0196-0005	Correspondence, dated February 5, 2013, from Bruce H. Palin, Assistant Commissioner, Office of Land Quality, Indiana Department of Environmental Management
EPA-HQ-SFUND-2013-0196-0006	Comment, dated June 20, 2013, handwritten comments from participants of two community meetings held by EPA on June 13, 2013, regarding the Beck's Lake site, South Bend, IN
EPA-HQ-SFUND-2013-0196-0007	Comment, dated July 23, 2013, from Stephen D. Murray, CPG, Principal Project Manager and Peter D. Neithercut, PE, Senior Principal Engineer, AMEC Environment & Infrastructure, Inc., at the request of Honeywell International

2. Site Description

The Beck's Lake site consists of a landfill and contaminated soil located at and near the intersection of Washington and Falcon Streets and adjacent to LaSalle Park on the northwest side of South Bend, Indiana (see Figures 1 and 2 of this support document). The area surrounding LaSalle Park consists mostly of older single- and multi-family residences in a typical urban setting. Directly adjacent to LaSalle Park on the west across Falcon Street is a new complex of subsidized housing and apartments called LaSalle Park Homes. Portions of the current LaSalle Park were used as a dump and landfill from approximately 1938 through the mid-1950s. Numerous companies and individuals have reportedly dumped a variety of materials containing hazardous substances at this location; these materials include asbestos, plating wastes, solvents, paint wastes, sludges, and foundry sand. Foundry sand and sludge contain arsenic and other contaminants.

The area of concern includes the dump area and the area immediately surrounding LaSalle Park to the west and south-southwest where levels of arsenic elevated above background levels were identified during the 2001 Brownfields Environmental Assessment and the 1996 initial Expanded Site Inspection (ESI) for the Site. In a 1951 historical aerial photograph of the area, the dumping area is evident and appears to extend to the edge of the partial road which is now Falcon Street. Also visible on the photograph are truck paths extending beyond the edge of the partial road into the area that is now part of the LaSalle Park Homes. Therefore, it appears from historical aerial photographs that before the LaSalle Park Homes were built, the waste that was deposited in the Beck's Lake landfill could also have been deposited on the current LaSalle Park Homes property.

Results of the 2009 ESI (the ESI 2) included three soil samples collected at the LaSalle Park Homes, which contain arsenic at concentrations above background and above health-based benchmarks. These three samples (indicated on Figures 1 and 2 of this support document as samples S3, S8 and S14) comprise the area of observed contamination (AOC) at the Site. The targets at the Site include 89 homes within 200 feet of the AOC that are scored at Level I contamination based on these three soil samples at the LaSalle Park Homes residential properties.

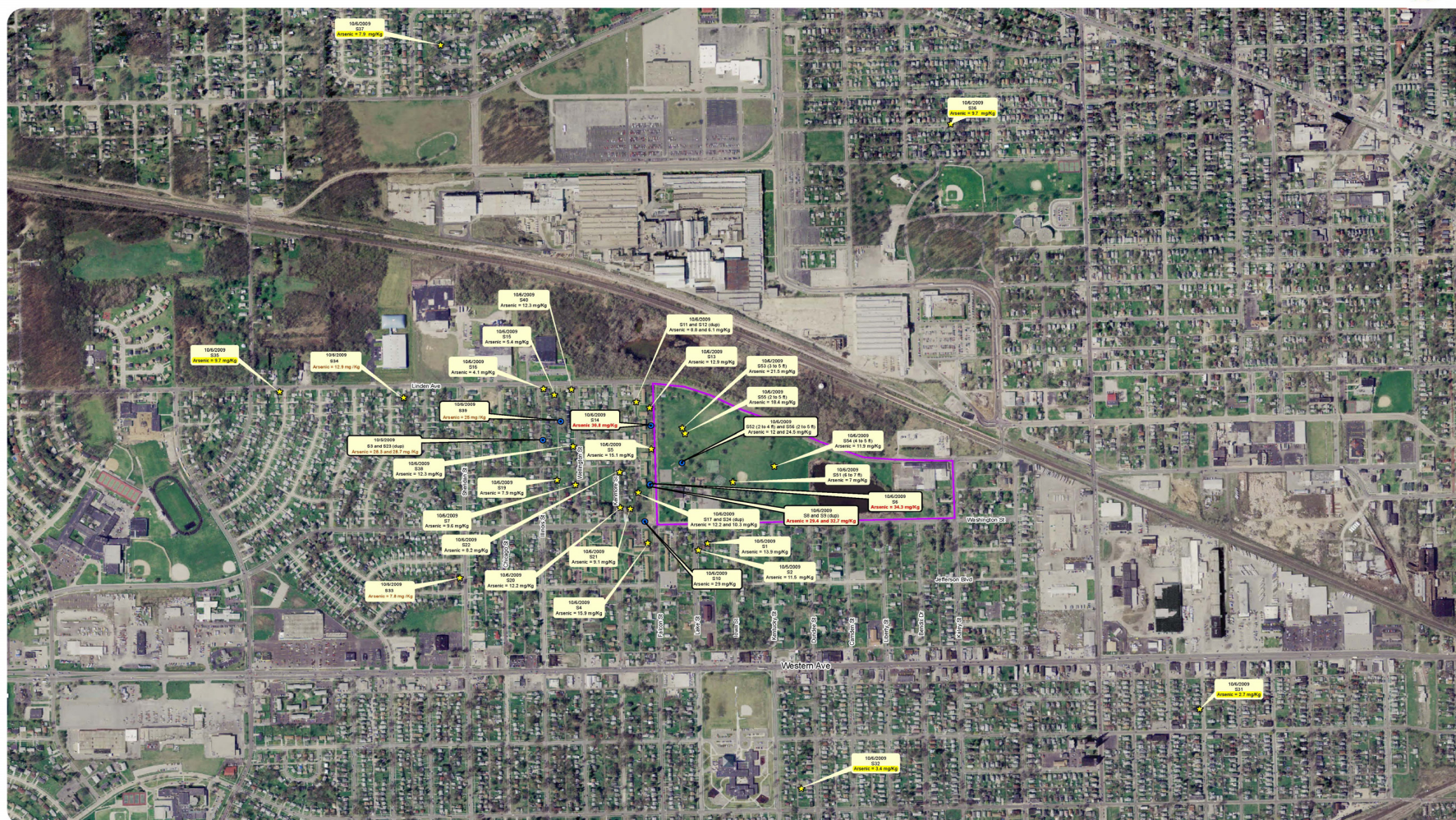
Table 1 shows arsenic concentrations found in background, “step out”¹, and observed contamination samples identified during the Hazard Ranking System (HRS) evaluation.

Table 1: Background, “Step Out” and Observed Contamination Sample Arsenic Concentrations (Concentrations from Reference 14 of the HRS Documentation Record)	
Background Samples	
Sample ID	Arsenic Concentration (mg/kg)
S31	2.7
S32	3.4
S35	9.7
S36	9.7
S37	7.9
“Step Out” Samples	
Sample ID	Arsenic Concentration (mg/kg)
S3	28.3
S23 (duplicate of S3)	28.7
S33	7.8
S34	12.9
S39	25
Observed Contamination Samples	
Sample ID	Arsenic Concentration (mg/kg)
S6	34.3
S8	29.4
S9 (duplicate of S8)	32.7
S14	30.8

¹ “Step out” samples are soil samples that are collected at increasing distance from the center of contamination to determine the geographic extent of contamination.



**Arsenic Concentrations for Beck's Lake
EPA ID Number IND980904379
South Bend, St. Joseph County**



- Beck's Lake/LaSalle Park
- ★ Arsenic < 23.7 mg/Kg
- Arsenic > 23.7 mg/Kg
- Samples Meeting Observed Contamination Criteria
- Background Samples
- "Step Out" Samples

This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By:
John Winkler, Office of Land Quality
Date: 1/12/2010

Source:
Aerial Orthorectification
Data: Cleaned through GPS, collected by IDEM
Orthorectification: Derived from Indiana Map Framework Data
Map Projection: UTM Zone 18 N Map Datum: NAD83

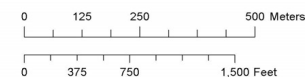


Figure 1 - Map of soil sample locations at the Beck's Lake site. (Figure 1 is based on page 1 of Reference 14 of the HRS documentation record at proposal, and has been modified to add locations of background samples and samples that meet observed release criteria; this figure includes all of the soil sample locations identified in the Beck's Lake HRS documentation record at proposal.)



Figure 2 – Enlarged map of Figure 1 showing soil sample locations centered on and around the LaSalle Park area at the Beck's Lake site.

3. Summary of Comments

Thomas W. Easterly, Commissioner of the Indiana Department of Environmental Management, recommended that the Beck's Lake site be placed on the NPL, as did 56 participants at two community meetings regarding the Beck's Lake site. These meetings took place on June 13, 2013, organized by the U.S. Environmental Protection Agency (EPA), Region 5.

AMEC Environment & Infrastructure, Inc. (AMEC), at the request of Honeywell International, submitted comments in opposition to placing the Beck's Lake site on the NPL. AMEC commented that neither the EPA nor the Indiana Department of Environmental Management (IDEM) followed the HRS or HRS guidance in placing the Site on the NPL. AMEC also commented that the EPA failed to provide a rationale for determining the background level for arsenic.

AMEC commented that the background concentrations used during the HRS evaluation did not accurately reflect background levels identified during sampling events. AMEC's main eligibility comment concerned the identification of the background level for arsenic used in the HRS evaluation. AMEC commented that the HRS evaluation used a different background determination than the 2009 ESI Report. AMEC further asserted that if the background level used in the 2009 ESI Report were used, then the arsenic results used in the HRS evaluation would not exceed the three times-background concentration threshold.

Additionally, AMEC asserted that the HRS evaluation did not provide rationale for sample selection for background samples. AMEC further commented that an insufficient number of background samples were collected to adequately determine a background threshold level.

Finally, AMEC commented that the documentation provided "to date" (at the time of its comments dated July 23, 2013) did not identify the background sample locations. AMEC commented that it requested documentation that would identify the sample locations, but because the work plan (for the Expanded Site Inspection) was not available through the IDEM virtual file cabinet, AMEC commented that it was not able to determine the background sample locations.

3.1 Support for Listing and Other Non-opposition Comments

Comment: On February 5, 2013, Bruce H. Palin, Assistant Commissioner, Office of Land Quality, Indiana Department of Environmental Management (IDEM), wrote to convey IDEM Commissioner Thomas W. Easterly's continued support for listing the Beck's Lake site on the National Priorities List (NPL).

A total of 56 written comments from concerned citizens in support of placing the Beck's Lake site on the NPL were collected by the EPA Region 5, during two community meetings regarding the Beck's Lake site it held on June 13, 2013.

Response: The Beck's Lake site is being added to the NPL. Listing makes a site eligible for remedial action funding under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and the EPA will examine the Site to determine the appropriate response action(s). Actual funding may not necessarily be undertaken in the precise order of HRS scores. In addition, upon more detailed investigation remedial action may not be necessary at all in some cases. The need for using Superfund monies for remedial activities will be determined on a site-by-site basis, taking into account the NPL ranking, State priorities, further site investigation, other response alternatives, and other factors as appropriate.

3.2 Availability of Documentation

Comment: AMEC commented that the documentation provided “to date” (at the time of its comments dated July 23, 2013) did not identify the background sample locations. AMEC commented that it requested documentation that would identify the sample locations, but because the work plan (for the Expanded Site Inspection) was not available through the IDEM virtual file cabinet, AMEC commented that it was not able to determine the background sample locations. AMEC commented that it requested the work plan but did not receive the document prior to submitting comments.

Response: The HRS documentation record at proposal describes the background sample locations and Reference 14 was cited to identify the background sample locations in a figure; this reference was available at the time of proposal (May 24, 2012). The work plan for the expanded site inspection (ESI) was publicly available as Reference 12 of the HRS documentation record at proposal; it was available in the EPA Region 5 Docket at the time of proposal. In addition, AMEC received the work plan on July 22, 2013, (which is within the comment period, which ended July 23, 2013 at 11:59 pm, for the proposed rule) via a FOIA request (see Attachment 1 of this support document and details of the FOIA request described below).

To obtain the HRS documentation package for this site (including Reference 12 to the HRS documentation record), the preamble to the proposed rule in the *Federal Register* notice (78 FR 31464, May 24, 2013) instructs:

You may view the documents, by appointment only, in the Headquarters or the Regional Dockets after the publication of this proposed rule. The hours of operation for the Headquarters Docket are from 8:30 a.m. to 4:30 p.m., Monday through Friday excluding federal holidays. Please contact the Regional Dockets for hours...

You may also request copies from the EPA Headquarters or the Regional Dockets. An informal request, rather than a formal written request under the Freedom of Information Act, should be the ordinary procedure for obtaining copies of any of these documents. Please note that due to the difficulty of reproducing oversized maps, oversized maps may be viewed only in-person; since the EPA dockets are not equipped to either copy and mail out such maps or scan them and send them out electronically.

Regarding AMEC’s specific request for additional documentation (the work plan), while no specific information was provided by AMEC in its comments about its requests for documentation, a FOIA request by Mr. Steven E. Murray of AMEC was submitted on June 21, 2013, to which the EPA fully responded (see Attachment 1 of this support document for supporting documentation). The FOIA request, which included the work plan in question (Reference 12 of the HRS documentation record at proposal), was completed within the time outlined on the request and the request was fulfilled on July 22, 2013, before the comment period closing date which ended July 23, 2013 at 11:59 pm (see Attachment 1 of this support document).

As stated in the preamble to the proposed rule, the documents that were requested through the FOIA request were available in the EPA Region 5 docket and were accessible throughout the comment period. While AMEC did not follow the procedures outlined in the preamble to the proposed rule, these documents were available to the public throughout the comment period (comments regarding the documentation of the sample locations are discussed in section 3.6.1, Presentation of Background Sample Locations, of this support document); the preamble clearly stated how to expeditiously obtain the documents and made clear that a formal FOIA request was not the usual procedure for doing so.

This comment results in no change to the HRS score and no change in the decision to place the Site on the NPL.

3.3 Consistency with Regulatory Requirements

Comment: AMEC commented that the proposed listing is “not consistent with regulatory requirements.” AMEC particularly commented that the “background threshold” had not been established according to guidance. AMEC argued that the Site should not be listed on the NPL because the information provided to date has not provided a rationale for determining background levels.

Response: All administrative and regulatory requirements for placing the Beck's Lake site on the NPL in the National Oil and Hazardous Substances Pollution Contingency Plan, the NCP, (Code of Federal Regulations [40 CFR 300]) including those in the HRS (40 CFR 300, Appendix A) have been met. This includes those requirements for establishing the background threshold used in the HRS evaluation. The evaluation of the Site using the HRS and the listing of the Site on the NPL are consistent with CERCLA, its associated regulatory requirements, and the Administrative Procedure Act (APA) (78 FR 31464, May 24, 2013). The CERCLA requirements for placing the Beck's Lake site on the NPL are embodied in the NCP (40 CFR 300).

Public notice of the proposal of the Site was published in the *Federal Register* on May 24, 2013 (78 FR 31464). The HRS score of 50.00 for the Site is above the listing cut off score of 28.50 (78 FR 31466, May 24, 2013). The rationale for the score is presented in the HRS documentation package and is consistent with the HRS. Public notice of the proposal to add the site to the NPL and the rationale for the score were made available to the public at the time of proposal (78 FR 31464, May 24, 2013). This support document responds to all comments submitted on the proposed action, including comments regarding the rationale for the determination of the background level used to identify a significant increase in arsenic levels due to a release from the Site.

Regarding establishment of a background threshold, as discussed in section 3.6, Establishment of Background Levels, of this support document, the background threshold used to document an area of observed exposure was correctly determined consistent with HRS Sections 2.3, Likelihood of release, and 5.0.1, General considerations.

This comment results in no change to the HRS score and no change in the decision to place the Site on the NPL.

3.4 Extent of Site

Comment: AMEC commented that the HRS documentation record does not clearly define the boundaries of the proposed site.

Response: At the listing stage of the Superfund process, the final site boundaries are not determined. For HRS scoring purposes, the Beck's Lake site, as discussed on page 9 of the HRS documentation record at proposal, “consists of a landfill and contaminated soil located at and near the intersection of Washington and Falcon streets on the northwest side of South Bend, Indiana, and adjacent to LaSalle Park (Ref. 5, p. 13).”

As stated on page 1 of the HRS documentation record at proposal, the boundaries of the Site are not exactly delineated:

The street address, coordinates, and contaminant locations presented in this HRS documentation record identify the general area the Site is located. They represent one or more locations EPA considers to be part of the Site based on the screening information EPA used to evaluate the Site for NPL listing. EPA lists national priorities among the known “releases or threatened releases” of hazardous substances; thus, the focus is on the release, not precisely delineated boundaries. ...Generally, HRS scoring and the subsequent listing of a release merely represent the initial determination that a certain area may need to be addressed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Accordingly, EPA

contemplates that the preliminary description of facility boundaries at the time of scoring will be refined as more information is developed as to where the contamination has come to be located.

Additionally, as explained in Part I, Section F, Does the NPL Define Boundaries of Sites?, of the *Federal Register* notice announcing proposal to add the Site to the NPL (78 FR 31464, May 24, 2013):

The NPL does not describe releases in precise geographical terms; it would be neither feasible nor consistent with the limited purpose of the NPL (to identify releases that are priorities for further evaluation), for it to do so. Indeed, the precise nature and extent of the site are typically not known at the time of listing. Although a CERCLA "facility" is broadly defined to include any area where a hazardous substance has "come to be located" (CERCLA section 101(9)), the listing process itself is not intended to define or reflect the boundaries of such facilities or releases . . . [, and] while geographic terms are often used to designate the site (e.g., the "Jones Co. plant site") in terms of the property owned by a particular party, the site, properly understood, is not limited to that property (e.g., it may extend beyond the property due to contaminant migration), and conversely may not occupy the full extent of the property (e.g., where there are uncontaminated parts of the identified property, they may not be, strictly speaking, part of the "site").

Thus, the final site boundaries are not determined at the listing stage of the Superfund process and the HRS evaluation appropriately evaluated the extent of the Site for listing purposes.

This comment results in no change to the HRS score and no change in the decision to place the Site on the NPL.

3.5 Consistency with Guidance

Comment: AMEC commented that "neither EPA nor IDEM appear to have followed relevant guidance on determining the appropriate background threshold level for arsenic." AMEC stated that "EPA did not utilize a consistent evaluation process for developing a reasonable determination of background arsenic levels, or even one rooted in the relevant technical guidance." AMEC commented that the "EPA has published guidance for calculating background concentrations at CERCLA Sites (EPA, 2002 EPA 540-R-01-003) and (EPA, 2007, EPA/600/R-07/020)" and that IDEM provides relevant guidance in Section 6.1 of IDEM's Remediation Closure Guidance. AMEC specifically pointed out that the IDEM guidance states that 8-10 samples should be used to calculate the background threshold value.

Response: The EPA applied the HRS to place the Site on the NPL. The background threshold value used to establish observed contamination at the Beck's Lake site in the HRS evaluation was determined consistent with the HRS. That is, the background threshold is three times the background concentration (level), and concentrations at or above that threshold are used to establish observed release (see section 3.6, Establishment of Background Levels, of this support document for a full discussion). The three guidance documents that AMEC cited in its comments are not applicable to an HRS evaluation; rather, they are applicable to making a site-specific, risk-based remedial decision, which is not required when placing a site on the NPL. An HRS evaluation is based on screening data gathered during the preliminary assessment and site inspection (PA/SI) stage of the CERCLA process and occurs before a site is placed on the NPL. Therefore, the guidance cited by AMEC applies to different stages in the CERCLA process or in the State of Indiana site closure process, which require more extensive site data collection efforts than undertaken during the PA/SI. Furthermore, the "background" discussed in the guidance documents cited by AMEC is used for different purposes than in an HRS evaluation.

Specifically, the 2002 EPA guidance (EPA, 2002 EPA 540-R-01-003, *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites*), which AMEC cites in its comment, was developed for the remedial investigation (RI) stage of the CERCLA site remediation process that occurs after a site is placed on the NPL. Section 1.1, Application of Guidance, of the 2002 EPA guidance states: "This guidance should be applied

on a site-specific basis, with assistance from a statistician who is familiar with the CERCLA remedial investigation process.” The RI requires a more intense data collection effort that includes more field sampling to gain an expanded understanding of the issues at the site. The background level in the RI stage is used to establish the extent of the release and the risk level posed by the release from the site; whereas, the HRS evaluation establishes that observed contamination has occurred and that a site merits further investigation to determine the extent of the release and risk level. Establishing this risk background level requires a more intensive site evaluation effort than the PA/SI that is the basis of the HRS evaluation. Thus, the cited 2002 EPA guidance is not appropriate for use in determining the background level concentration of arsenic in an HRS evaluation.

The 2007 EPA document (EPA, 2007, EPA/600/R-07/020, *Performance of Statistical Tests for Site Versus Background Soil Comparisons When Distributional Assumptions Are Not Met*²) cited by AMEC in its comments also is not appropriate to be used as guidance when determining an HRS background threshold. The 2007 EPA document is a research paper exploring the performance of different statistical tests on background and “site” soil samples when the data has an unknown population distribution. The 2007 document states that for unknown population distributions, a sample size of at least 60 is required to meet the assumptions of the statistical tests performed (both background and “site” sample groups should contain, at a minimum, 30 samples). The 2007 EPA document uses a data set of more than 30 background samples and 122 total samples. As discussed above, this data collection effort is beyond the scope of a PA/SI that is the basis of an HRS evaluation and beyond the level of data available at this site. Additionally, the 2007 EPA document does not address the listing process or Superfund. The HRS evaluation of the Beck's Lake site was based on data from 5 background samples and 35 total samples. Thus, the 2007 document is not appropriate as guidance for assigning background concentrations in an HRS evaluation.

Regarding AMEC's comment that IDEM provides relevant guidance to establish site-specific background concentrations in its Remediation Closure Guidance document (IDEM, *Remediation Closure Guide*, March 22, 2012, Section 6), this guidance document pertains to remediation efforts (see page 12 in section 1.2, Applicability, of the Remediation Closure Guide) and is not applicable to stages of CERCLA prior to site listing. As with the two cited EPA documents, IDEM's guidance document was developed to evaluate sites later in the site investigation process; the data requirements of the site remediation stage of CERCLA require a larger data collection effort than the limited data available at the time of an HRS evaluation.

The method used in the HRS evaluation to assign a background level at the Beck's Lake site is consistent with the HRS, and is consistent with the only relevant guidance (*The Hazard Ranking System Guidance Manual, Interim Final*, November 1992³ [HRS Guidance Manual]) (see section 3.6, Establishment of Background Levels, of this support document).

This comment results in no change to the HRS score and no change in the decision to place the Site on the NPL.

3.6 Establishment of Background Levels

Comment: AMEC commented that the EPA provided no rationale or documentation of the background analysis for how the agency selected the samples that were used to establish the background level of arsenic at the Site. AMEC challenged the technical basis for the selected arsenic background level specifically:

- The selection of the background samples included in calculating the background level
 - The rationale for selecting background samples in the HRS documentation record
 - The rationale for not using the background level identified in the ESI

² An electronic copy of this report is available at: <http://www.epa.gov/esd/cmb/pdf/141pos07.pdf>

³ An electronic copy of the HRS Guidance Manual is available at: <http://www.epa.gov/superfund/sites/npl/hrsres/#HRS> Guidance (accessed 8/27/2013)

- The rationale for not using samples S33 and S34 as background samples
- The consistency of background samples with the national background levels
- The presentation of analysis to support the HRS documentation record background level

Response: The rationale for selecting the soil samples that were used to establish the background level⁴ of arsenic at the Site is provided in the HRS documentation record at proposal. The rationale provided in the HRS documentation record for selecting background samples is consistent with the HRS, and the background level for arsenic was correctly established according to the HRS.

Section 5.0.1, *General considerations*, of the HRS describes how background samples can be identified and states:

- ...
- Consider observed contamination to be present at sampling locations where analytic evidence indicates that:
 - A hazardous substance attributable to the site is present at a concentration significantly above background levels for the site (see Table 2-3 in section 2.3 for the criteria for determining analytical significance), *and...*

HRS Section 2.3, *Likelihood of release*, directs the scorer to use Table 2-3 for the soil exposure and states:

[T]he criteria in Table 2-3 are also used in establishing observed contamination for the soil exposure pathway.

HRS Table 2-3, *Observed Release Criteria for Chemical Analysis*, describes how an observed release sample is compared to a background sample and states:

Sample Measurement < Sample Quantitation Limit^a
No observed release is established.

Sample Measurement ≥ Sample Quantitation Limit^a
An observed release is established as follows:

- If the background concentration is not detected (or is less than the detection limit), an observed release is established when the sample measurement equals or exceeds the sample quantitation limit.^a

- If the background concentration equals or exceeds the detection limit, an observed release is established when the sample measurement is 3 times or more above the background concentration.** [emphasis added]

The HRS documentation record identifies the background samples used in determining the observed contamination.

Page 24 of the HRS documentation record at proposal provides the rationale for the selection of the background level used in establishing observed contamination:

⁴ Background samples are discrete samples used to establish a background level of a concentration of a hazardous substance. The background level provides a reference point to determine whether an observed release of a contaminant has occurred.

Arsenic concentrations ranged from 2.7 to 9.7 mg/kg in the five background samples (S31, S32, S35, S36 and S37) collected during the ESI 2 (Refs. 5, pp. 133, 134, 196; 17, pp. 61, 62, 64, 77-76, 106, 109, 115-117). The highest concentration of arsenic (9.7 mg/kg) was detected in the background samples S35 and S36 (Refs. 5, pp. 196, 17, pp. 115, 116). Three times the highest background concentration for arsenic is 29.1 mg/kg (3 times 9.7 mg/kg)...

The HRS documentation record at proposal provides the rationale for identifying the background sample locations used to establish observed contamination. Page 19 of the HRS documentation record at proposal states:

The background soil samples for this investigation were collected from the residential properties away from Beck's Lake (Ref. 5, p. 18). ...These locations were chosen to represent background conditions because: (1) the soil type at the background sample locations are similar to the soil types at the locations of samples collected from Area of Observed Contamination (AOC) A; (2) these sampling locations are at a distance away from Beck's Lake and appear to be minimally affected by operations at Beck's Lake; (3) samples were collected within same time period (October 5 and 6, 2009), therefore, under the same weather conditions; (4) samples were collected at the same depth of 0 to 6-inches; (5) samples were collected by the same sampling team and samples were collected in accordance with the approved Work Plan (Refs. 5, p. 18; 12, pp. 1-19; 13, pp. 1-14).

The HRS documentation record provided a rationale for selecting the background sample locations as well as the background level that was chosen to identify observed contamination. The background samples were collected from residential properties away from the Beck's Lake Park. Multiple background samples were collected because the extent of contamination at the Site has not been determined. Samples farthest from the center of contamination (the AOC) were chosen as the most representative of background conditions; the background sample with the highest concentration of arsenic was chosen for the background level (9.7 mg/kg) (see Figure 1 of this support document). The background level was established according to the HRS and the EPA provided a reasonable explanation for choosing the background level in the HRS documentation record at proposal. The following subsections address AMEC's specific comments regarding the establishment of a background arsenic level at the Site.

- 3.6.1 Presentation of Background Sample Locations
- 3.6.2 Rationale for Not Using the ESI Background Level
- 3.6.3 Rationale for Not Using Sample S34 as Background
- 3.6.4 Rationale for Not Using Sample S33 as Background
- 3.6.5 Adequacy of Background Locations
- 3.6.6 Consistency of Background Sample Concentrations with the National Background Levels
- 3.6.7 Presentation of Analysis to Support the Calculation of Background Levels

3.6.1 Presentation of Background Sample Locations

Comment: AMEC commented that the "documentation provided to date does not identify the specific sample locations used for calculating [a] background [level]" and stated that "in fact the exact locations are redacted from the available documentation."

Response: As referenced on page 20 of the HRS documentation record at proposal, the background sample locations were identified in Reference 5 and depicted in Reference 14 (see also Figure 1 of this support document) of the HRS documentation record at proposal.

Page 20 of the HRS documentation record at proposal directs the reader to the references in the HRS package that illustrate the background soil sample locations:

The locations of the background soil samples are described in Reference 5, page 18 and **depicted in Reference 14, page 1.** [emphasis added]

As discussed previously in section 3.2, Availability of Documentation, of this support document, HRS documentation record references are available in the Region 5 Docket. AMEC obtained these materials via a FOIA request (see section 3.2, Availability of Documentation, and Attachment 1 of this support document).

The Agency is unsure where AMEC is referring to that the sample locations are redacted. If AMEC is referring to the figures in Appendix C, F and G to Reference 5 of the HRS documentation record at proposal, the background sample locations are not redacted in these figures; rather, the sample locations were cropped out of the figures when the figures were blown up to show a more detailed view of the landfill area of the Site. Because these samples were cropped out of these figures, Reference 14 of the HRS documentation record at proposal was cited; Reference 14 is a figure showing all sample locations used in the establishment of observed contamination.

This comment results in no change to the HRS score and no change in the decision to place the site on the NPL.

3.6.2 Rationale for Not Using the ESI Background Level

Comment: AMEC commented that the 2009 ESI Report author used background sample S37 (7.9 mg/kg) to “establish the 3x background threshold of 23.7 mg/kg for arsenic.” AMEC commented that there was no explanation as to why samples S35 or S36 (which both contained 9.7 mg/kg arsenic) were not used to establish the background level in the 2009 ESI Report. AMEC also commented that there is no explanation as to why the HRS documentation record used a background value of 9.7 mg/kg and not the same value that was used in the 2009 ESI Report.

Response: The background level of 9.7 mg/kg for arsenic in soil and a background threshold of 29.1 mg/kg for arsenic used to establish observed contamination in the HRS documentation record at proposal are entirely reasonable for the purpose of establishing a significant increase in arsenic levels at the Site. This background level for arsenic was chosen for the HRS evaluation because it was the highest arsenic level in all the background samples. As such, it represents the highest arsenic concentration that could be present at the Site had a release from the site not occurred. As presented in Figure 1 of this support document, samples S35 and S36 were located at similar distances from the center of arsenic concentration⁵ as S37 and thus were just as likely to reflect background arsenic concentrations in the vicinity of the site as S37 (i.e., levels present in the absence of the release being evaluated). While the background level established in the HRS documentation record is different from the background value in the 2009 ESI Report, the value assigned at proposal is a site-specific background level that is actually higher than the value used in the 2009 ESI Report and results in a higher background threshold level (29.1 versus 23.7 mg/kg). That a different document, the 2009 ESI Report, selected a different, lower background level does not alter this finding or show the rationale used in the HRS evaluation was incorrect.

As quoted in section 3.6 of this support document, to establish a significant increase in a hazardous substance concentration and thus establish observed contamination at a sample location, HRS Table 2.3 requires a threefold increase in release sample concentration above background levels when the background concentration is above the detection limit (see HRS sections 5.0.1 and 2.3 as quoted in section 3.6 of this support document).

⁵The “center of arsenic contamination” (the AOC) refers to the area of contaminated soil samples at Beck's Lake that contains arsenic concentrations above 30 mg/kg arsenic. These samples are identified in figure 1 of this support document.

The HRS documentation record explains on page 24 that a value of 9.7 mg/kg arsenic was used as a background level because it was the highest concentration determined in any of the background samples:

Arsenic concentrations ranged from 2.7 to 9.7 mg/kg in the five background samples (S31, S32, S35, S36 and S37) collected during the ESI 2 (Refs. 5, pp. 133, 134, 196; 17, pp. 61, 62, 64, 77-76, 106, 109, 115-117). The highest concentration of arsenic (9.7 mg/kg) was detected in the background samples S35 and S36 (Refs. 5, pp. 196, 17, pp. 115, 116).

As quoted above and shown in Reference 5 (2009 ESI Report) to the HRS documentation record at proposal, the background sample concentrations for arsenic at the Site ranged from 2.7 to 9.7 mg/kg. As explained on page 24 of the HRS documentation record at proposal, the EPA established the background level using the highest concentration of arsenic found in the designated background samples (as noted in section 3.6 of this support document, the background sample locations were chosen based on several reasons, including distance from the Site). Since background samples S35 and S36 were found to contain 9.7 mg/kg arsenic, as documented in the data from the 2009 ESI Report, the HRS documentation record established the background level of 9.7 mg/kg, the highest concentration identified in any background sample. Using the highest background sample concentration assures that the HRS requirement of a threefold increase above background concentration has been met at the Site.

Regarding the comment that the 2009 ESI Report does not provide an explanation for not using the arsenic concentrations in samples S35 and S36 as the background level, the ESI background level rationale is not required to be used in the HRS evaluation. As part of the HRS scoring process, the EPA determined that sample locations S35 and S36 were as representative of background conditions as the sample S37 background location, and determined that there was no reason to not use the higher concentrations, which in fact make the presence of contamination more of a certainty than using a lower concentration, in setting the background level.

However, even if the EPA had identified the background level at the Site as 7.9 mg/kg (and a background threshold of 23.7 mg/kg) consistent with the 2009 ESI Report, there would be no negative impact to the Site score or the listing decision. In fact, in that case arsenic concentrations from more sample locations would qualify as meeting observed contamination (three times background level) and the AOC would expand (e.g., samples S39 [25 mg/kg], S3 [28.3 mg/kg], and S23 [28.7 mg/kg] would meet observed release requirements; see Figure 1 of this support document). This impact would only increase the extent of AOC at the site and possibly raise the targets score.

Furthermore, if during further investigation of a site, a different background level is selected, e.g., for purposes of determining acceptable risk or extent of remediation (if remediation is determined to be necessary), that value will be used for those purposes; however, that value does not necessarily apply for HRS purposes.

This comment results in no change to the HRS score and no change in the decision to place the Site on the NPL.

3.6.3 Rationale for Not Using Sample S34 as Background

Comment: AMEC commented that soil sample S34 was identified as a background sample in the 2009 ESI Report but was not used as a background sample in the HRS documentation record. AMEC noted that the HRS documentation record states that sample S34 was “mistakenly identified as a background sample” but the 2009 ESI Report did not reflect the same concern. AMEC commented that while IDEM attests that sample S34 was collected as a “step out” sample due to elevated levels of arsenic in sample S3 and its duplicate S23, the levels in samples S3 and S23 are not three times the threshold concentration presented in the HRS documentation record. Finally, AMEC commented that if S34 were used to establish the background threshold concentration, no arsenic results would meet the observed release criteria in the HRS and there would be no reason to list the Site on the NPL.

Response: Sample S34 was not selected as a representative background sample for establishing observed contamination because the sample location was sufficiently close to other samples that indicate elevated arsenic concentrations, and it (sample S34) was not determined to be outside of the contamination influence from the Site; therefore sample S34 was not determined to be representative of background conditions. This was supported by the finding that samples at greater distances from the site contamination but in the same general direction, showed a further decrease in arsenic levels with increased distance.

Page 21 of the HRS documentation record at proposal provides an explanation for why sample S34 was not used in calculating the background level:

The highest arsenic concentration in the background soil samples was 9.7 mg/kg in samples S35 and S36 (Ref 5, p. 196). Surface soil sample S34 was mistakenly identified as background sample in 2009 ESI 2 Report (Refs. 5, p. 18; 11, p. 1)...

Sample S34 was included in the Sample Location and Comment Table on page 18 of the 2009 ESI Report, but was not used in determining a background level in the 2009 ESI Report. Page 19 of the 2009 ESI Report identifies the highest background concentration of arsenic as 7.9 mg/kg, which is below the 12.9 mg/kg concentration of sample S34, as indicated on page 196 of the 2009 ESI Report. This indicates that the 2009 ESI Report did not select sample S34 as representative of background conditions. Sample S34 was identified as a “step out” sample because it showed decreasing concentrations from the center of arsenic contamination at the Site (see Figure 1 of this support document).

Sample S34 was not identified as a background sample in the HRS documentation record or used in determining a background level because it was relatively close to samples with arsenic contamination, and had a higher arsenic concentration than the next more distant sample. Samples S39 (25 mg/kg), S3 (28.3 mg/kg), and S23 (28.7 mg/kg), which are located between the AOC and sample S34, indicate elevated levels of arsenic contamination (see Table 1 of this support document). As shown in Figure 1 of this support document, sample S34 is located approximately ¼ mile west of sample S39, S3, and S23 locations. Sample S35, the next farther distant sample (approximately 1/5 mile west of sample S34), has a concentration of 9.7 mg/kg, as indicated on page 196 of the 2009 ESI Report (see Table 1 of this support document). This pattern of decreasing concentration with distance indicates that sample S34 is not an appropriate background sample because it could still be influenced by the release of arsenic from the Site source.

Regarding AMEC's comment that while the HRS documentation record states that sample S34 was “mistakenly identified as a background sample” in the 2009 ESI Report, the 2009 ESI Report does not share the same concern about the sample; Reference 11 of the HRS documentation record at proposal supports the statement that sample S34 was mistakenly identified in the 2009 ESI Report. Even if it were true that the 2009 ESI Report does not share the same concern about sample S34, the HRS evaluation is not required to reach the same conclusions as previous reports; rather, it uses data from previous reports to assign an HRS score using HRS-specific criteria.

While sample S34 is referenced in the HRS documentation record at proposal on page 21, as being “mistakenly identified as background sample” in the 2009 ESI Report, the author of the 2009 ESI Report, Timothy Johnson, submitted an affidavit (Reference 11 of the HRS documentation record at proposal) which states:

On page 11 of the ESI 2, I erroneously identified sample S34 (ME2QX7) as a background sample on a sample summary table for the site. Sample S34 was not collected as a background sample... Sample S34 was collected as a step out sample because of the high levels of arsenic displayed in samples S39, and S3/S23...

This affidavit statement is consistent with sample S34 being identified as a “step out” sample and not as a background sample in the HRS documentation record at proposal.

This comment results in no change to the HRS score and no change in the decision to place the Site on the NPL.

3.6.4 Rationale for Not Using Sample S33 as Background

Comment: AMEC commented that background sample S33 was “rejected” in the HRS documentation record for use in assigning a background level because it was considered to be “too close to the site.” However, AMEC noted that the HRS documentation record did not reject sample S34 based on the proximity of this sample location to the Site.

Response: It is correct that sample S33 was not used as a background sample because of its location being close to the Site. At the time of the sampling event, the extent of contamination had not been determined and because sample S33 was “close to the site” it was not originally chosen as a background location. Neither sample S33 nor sample S34 was used to establish a background arsenic level for identifying observed contamination at the Site in the HRS evaluation. The rationale for not using sample S33 (i.e., proximity to the Site) is consistent with the rationale and decision to not use sample S34 to establish a background level (sample S34 was considered a “step out” sample as explained below in this section). In fact, both rationales reflect that the distance of the sample location from the center of arsenic contamination is the reason that they were not selected as representative background samples. Additionally, even if sample S33 were used as a background sample, there would be no change in the established background level.

Page 21 of the HRS documentation record at proposal provides the rationale for excluding samples S33 and S34 as background samples:

Surface soil sample S34 was mistakenly identified as background sample in 2009 ESI 2 Report (Refs. 5, p. 18; 11, p. 1). The initially designated background soil sample S33 appears to be much closer to the AOC and therefore, is also not considered as a background sample.

As explained in section 3.6.3, Rationale for Not Using Sample S34 as Background, of this support document, sample S34 was not included as a background sample due to elevated levels of arsenic in nearby samples. The location of sample S34 was sufficiently close to site-related contamination to not be representative of background conditions (i.e., concentrations absent the release from the Site). Therefore, although not specifically stated in the HRS documentation record, sample S34 was not considered a background sample due to its proximity to the Site contamination, which is consistent with the reasoning for the exclusion of sample S33 from being a background sample.

While the rationale in the HRS documentation record for not including sample S33 is that sample S33 was located “too close to the site,” sample S33 is not associated with “step out” samples that extend from the center of the arsenic contamination to sample S33 (see Figure 1 of this support document). Sample S35 has “step out” samples S34, S39, S3, and S23 between the center of the arsenic contamination and the background samples that help to indicate where the boundary of the site-related contamination is located. Because of the lack of “step out” samples to help indicate the boundary of the site-related contamination and where a background sample should be taken, sample S33 was not specifically identified as a background sample for use in establishing a background level.

However, even if sample S33 were used as a background sample for the HRS evaluation, the background level of arsenic would remain unchanged. The arsenic concentration in sample S33 was 7.8 mg/kg (see Figure 1 and Table 1 of this support document); this concentration is below the highest background concentration (9.7 mg/kg in samples S35 and S36) used to establish the background level in the HRS evaluation. Thus, if sample S33 were evaluated as a background sample in the HRS documentation record, it would not alter the background level established. As explained above in section 3.6.2, Rationale for Not Using the ESI Background Level, of this support document, the highest arsenic concentration found in a background sample was selected as the

background level to ensure that the resulting release sample concentrations meet the significant increase criteria of the HRS.

This comment results in no change to the HRS score and no change in the decision to place the Site on the NPL.

3.6.5 Adequacy of Background Locations

Comment: AMEC commented that there are background samples in all quadrants except the southwest direction and the HRS documentation record does not contain an explanation for this exception.

Response: The HRS evaluation appropriately selected background sample locations to determine a background level for arsenic for use in establishing that a significant increase in arsenic levels occurred at the Site and to screen out alternative sources that could be contributing to the significant increase in arsenic contamination at the Site. It is not necessary at this site to have background samples located in each (compass) quadrant to establish attribution.

As quoted in section 3.6, Establishment of Background Levels, of this support document, the HRS only states that to establish observed contamination (or observed releases), the release concentration must be at least three times greater than the background concentration (see HRS Table 2.3).

However, because the background level is used to show that a significant increase has occurred in contaminant concentration based on the magnitude of the difference in the contaminant levels due to the release from a site, the background samples are collected from locations outside the influence of the site. Further, the background samples should be located between any other known non-site sources of the same contaminants and the site. Contaminant levels in these samples would screen for contamination coming from these other sites.

The HRS documentation record states that background sample locations were chosen to be representative of background conditions. Page 19 of the HRS documentation record at proposal states:

The background soil samples for this investigation were collected from the residential properties away from Beck's Lake (Ref. 5, p. 18). ...These locations were chosen to represent background conditions because: (1) the soil type at the background sample locations are similar to the soil types at the locations of samples collected from Area of Observed Contamination (AOC) A; (2) **theses sampling locations are at a distance away from Beck's Lake and appear to be minimally affected by operations at Beck's Lake;** (3) samples were collected within same time period (October 5 and 6, 2009), therefore, under the same weather conditions; (4) samples were collected at the same depth of 0 to 6-inches; (5) samples were collected by the same sampling team and samples were collected in accordance with the approved Work Plan (Refs. 5, p. 18; 12, pp. 1-19; 13, pp. 1-14). [emphasis added]

The HRS evaluation appropriately selected background sample locations to determine a background level and screen out alternative sources. As explained previously in sections 3.6.2, Rationale for Not Using the ESI Background Level, and 3.6.3, Rationale for Not Using Sample S34 as Background, of this support document, samples S31, S32, S35, S36, and S37 were selected as background samples for the HRS evaluation because their locations were the most distant from the center of the highest arsenic contamination (see Figure 1 of this support document). Sample S33 (located in the southwest quadrant) was not identified as a background sample. This is because the sample is located slightly nearer to the center of arsenic contamination than other background sample locations and because no "step out" samples are associated with the sample location to show that the sample is located outside of the influence from the Site. However, the arsenic concentration identified in sample S33 (7.8 mg/kg) is lower than the selected background level (see Table 1 of this support document), indicating that it is outside of the influence of the release from the Site.

Additionally, sample S33 results support that there does not appear to be another source of arsenic in the southwest quadrant contributing to the arsenic contamination at the Site. In fact, no alternative source of arsenic is known to be located in the southwest quadrant, and AMEC did not identify any alternative arsenic sources in the vicinity of the Site. If a source of arsenic were present in the southwest quadrant, the arsenic level in S33 would be expected to be higher than in other areas where no source is known. As discussed above, the arsenic concentration of 7.8 mg/kg in sample S33 is lower than in other background locations in other directional quadrants, such as background samples S35 (9.7 mg/kg), S37 (7.9 mg/kg) and S36 (9.7 mg/kg) (see Table 1 of this support document).

Therefore, the chosen background sample locations were properly used to establish a background level and screen out alternative sources of arsenic that could be contributing to the Site contamination. Furthermore, as noted previously, if sample S33 were used as a background sample, it would not impact the background level for the Site.

This comment results in no change to the HRS score and no change in decision to place the Site on the NPL.

3.6.6 Consistency of Background Sample Concentrations with the National Background Levels

Comment: AMEC commented that a 1984 United States Geological Survey (USGS) report depicts a range of arsenic background levels throughout the United States as ranging from 1 mg/kg to 29 mg/kg, and AMEC stated that S34 reasonably falls within this range of background values.

Response: Although AMEC provided no specific citation to the 1984 USGS report it discussed in its comments, AMEC is most likely referring to the Shacklette and Boerngen 1984 USGS Professional Paper titled, *Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States* (1984 USGS paper; Attachment 2 to this support document). The background level of 9.7 mg/kg used in the Beck's Lake HRS evaluation is more consistent with the information in the 1984 USGS paper than the arsenic concentration identified in sample S34 (12.9 mg/kg). Therefore, the data presented in the USGS paper provides support for the EPA's decision to use a background level of 9.7 mg/kg. The arsenic data presented in the 1984 USGS paper supports a regional background concentration level below the level identified in sample S34 (12.9 mg/kg).

In the 1984 USGS paper, samples located nearest to the Beck's Lake site, as well as the site-specific background samples collected in the 2009 ESI Report, show that site-specific natural levels of arsenic in soils are lower than that observed in sample S34. The 1984 USGS paper provides a table on page 6 that summarizes the mean concentrations and ranges of elements in soil samples that were collected across the country. This table (Table 2 of the 1984 USGS paper) is divided into three categories: Conterminous United States, Western United States, and Eastern United States. This report depicts a range of arsenic levels throughout the Conterminous U.S. (Table 2 of the 1984 USGS paper states that arsenic concentrations in the U.S. range from <0.1 to 97 parts per million⁶ [ppm] as opposed to ranging from 1 to 29 ppm as cited by AMEC). In addition, this table states that the geometric mean concentration for arsenic east of the 96th meridian (Eastern United States) is 4.8 ppm with an estimated arithmetic mean of 7.4 ppm; both of these values are below the background level for the Beck's Lake site of 9.7 mg/kg established in the HRS evaluation.

⁶ The 1984 USGS paper used different reporting methods and analysis than the 2009 ESI Report. The 1984 USGS paper provides concentrations in µg/g whereas the 2009 ESI Report provides concentrations in mg/kg. However, both of these are reported in parts per million and thus are comparable.

In addition to Table 2 of the 1984 USGS paper, Figure 4 on pages 18 and 19 of the paper show all of the locations of the samples collected across the United States and the concentration of arsenic found at each location. This figure shows that the closest sample taken to the Beck's Lake site contains 4.1 ppm arsenic (with nearby concentrations ranging from <0.1 to 6.5 ppm arsenic). The selected background level of 9.7 mg/kg arsenic is actually closer to this value located nearest to the site in Figure 4 of the USGS paper (4.1 ppm) and to the national arithmetic mean value of arsenic for the Eastern United States (7.4 ppm) than the value of 12.9 mg/kg found in sample S34.

Overall, while the 1984 USGS paper indicates that there is a large range of natural arsenic concentrations throughout the United States, the paper suggests that regional natural levels of arsenic near the Beck's Lake site are possibly lower than the site-specific background level of 9.7 mg/kg established in the HRS evaluation.

This comment results in no change to the HRS score and no change in the decision to place the Site on the NPL.

3.6.7 Presentation of Analysis to Support the Calculation of Background Levels

Comment: AMEC commented that there was no statistical evaluation presented in the HRS documentation record or in the 2009 ESI Report that supported the calculation of the background levels. AMEC concluded that there was "no statistical basis to reject S34 as a background sample."

Response: The background levels used in the HRS documentation record were correctly calculated consistent with the HRS as presented in the HRS documentation record at proposal. As established in section 3.5, Consistency with Guidance, of this support document, the HRS is a screening tool that uses limited sampling data; therefore, the HRS does not require that a statistical analysis be performed as part of an HRS evaluation of the soil exposure pathway. The HRS does not require a statistical analysis to be performed to establish the presence of observed contamination or to determine background samples or background levels, instead it requires a specific magnitude of increase in contaminant levels over background level to demonstrate a release.

As discussed in section 3.6.3, Rationale for Not Using Sample S34 as Background, of this support document, sample S34 was never intended as a background sample for the Site as part of the HRS evaluation and was not rejected as a background sample based on a statistical analysis. Sample S34 is located near sample locations that contain elevated arsenic concentrations. Sample S34 contains a higher arsenic concentration than a more distant sample (S35) in the same direction, and this demonstrates decreasing arsenic concentration as the distance from the center of arsenic contamination increases. Thus it was considered that arsenic contamination in sample S34 may represent contamination from the Site and may not be representative of background conditions.

Instead of applying a statistical analysis to establish observed contamination, which includes the use of a background concentration, the HRS uses the requirements of Table 2.3 of the HRS to show that a significant increase in contamination levels between background and release samples has occurred. This procedure was contained in the HRS when it was promulgated in 1990 (55 FR 51589, December 14, 1990), and its validity is outside the scope of this rulemaking.

This comment results in no change to the HRS score and no change in the decision to place the Site on the NPL.

4. Conclusion

The original HRS score for this site was 50.00. Based on the above responses to comments, the Site score remains unchanged. The final scores for the Beck's Lake site are:

Ground Water	Not Scored
Surface Water	Not Scored
Soil Exposure	100.00
Air	Not Scored
HRS Site Score	50.00

Attachment 1

Documentation of AMEC Freedom of Information Act (FOIA) request

Custom Report

Results 25

1

One item found.

Custom Report - 08/01/2013 03:05:43

<i>Tracking Number</i>	<i>Type</i>	<i>Requester</i>	<i>Submitted</i>	<i>Assigned To</i>	<i>Due</i>	<i>Status</i>	<i>Detail</i>
EPA-R5-2013-007584	Task	Steven D. Murray	06/24/2013	Noreen Weimer	07/23/2013	Closed	

1

One item found.

Note: Requester Organization is available upon export.

Task Details**Request Status :** *Closed* **Task Due Date :** 07/23/2013

Submitted

Evaluation

Assignment

Processing

Request Details

007584	Tracking Number :	^{Closed} EPA-R5- 2013-	Request Type :	FOIA
			Request Track :	Simple
			Submitted Date :	
	Requester :	Mr. Steven	06/21/2013	
	D. Murray			Due Date :
	Organization :	AMEC	07/23/2013	
	Environment and Infrastructure		Assigned To :	Anna Rzeznik (Region 5)
	Requester Has Account :	No	Last Assigned Date :	
	Email Address :		06/24/2013	
	steven.d.murray@amec.com		Last Assigned By :	Joseph Winfrey (Region 5)
Phone Number :	231-922- 9050		Fee Limit :	\$25.00
Fax Number :	231-922- 9055			
Address :	41 Hughes			
Drive				
	City :	Traverse City		
	State/Province :	MI		
	Zip Code/Postal Code :	49696		

Task Details

07/23/2013	Task Type :	Request Detail	Assigned To :	Noreen Weimer (Superfund Division)
	Due Date :		Last Assigned Date :	

Description : Beck's 06/24/2013

Lake Site
located in South Bend,
IndianaLast Assigned By : Evette
Jones
(Superfund Division)

Comments : NW 7/22/13

Submission Details
Review

Case File

Admin Cost

Assigned Tasks

Comments

Request HandlingRequester Info Available to the Yes
Public :Request Perfected : Yes
Perfected Date :

Request Track : Simple 06/24/2013

Fee Category :

Acknowledgement Sent Date:

Commercial

Unusual Circumstances ? No

Fee Waiver Requested: No

Fee Waiver Status: N/A

Expedited Processing Requested : No

Expedited Processing Status : N/A

Request Description

Short Description : Beck's Lake Site located in South Bend, Indiana

Beck's Lake Site located in South Bend, Indiana

Description Available to the Yes
Public :Has Request Been Modified? ☐**Attached Supporting Files**Attachments Available to the Yes
Public :

Attached File	Type	Size (MB)
<i>steven.d.murray.pdf</i>	PDF	0.12

Task Details**Request Status :** *Closed* **Task Due Date :** 07/23/2013

Submitted

Evaluation

Assignment

Processing

Request Details

007584	Tracking Number : EPA-R5- 2013- Requester : Mr. Steven D. Murray Organization : AMEC Environment and Infrastructure Requester Has Account : No Email Address : steven.d.murray@amec.com Phone Number : 231-922- 9050 Fax Number : 231-922- 9055 Address : 41 Hughes Drive City : Traverse City State/Province : MI Zip Code/Postal Code : 49696	Request Type : FOIA Request Track : Simple Submitted Date : Due Date : Assigned To : Anna Rzeknik (Region 5) Last Assigned Date : Last Assigned By : Joseph Winfrey (Region 5) Fee Limit : \$25.00
--------	--	---

Task Details

07/23/2013	Task Type : Request Detail Due Date :	Assigned To : Noreen Weimer (Superfund Division) Last Assigned Date :
------------	---	--

Description : Beck's Lake Site
located in South Bend,
Indiana
Comments : NW 7/22/13

06/24/2013

Last Assigned By : Evette
Jones
(Superfund Division)

Submission Details
Review

Case File

Admin Cost

Assigned Tasks

Comments

Request Handling

Requester Info Available to the Yes
Public :

Request Perfected : Yes
Perfected Date :

Request Track : Simple 06/24/2013

Fee Category :

Acknowledgement Sent Date:

Commercial

Unusual Circumstances ? No

Fee Waiver Requested: No

Fee Waiver Status: N/A

Expedited Processing Requested : No


Expedited Processing Status : N/A

Request Description

Short Description : Beck's Lake Site located in South Bend, Indiana

Beck's Lake Site located in South Bend, Indiana

Description Available to the Yes
Public :

Has Request Been Modified? 

Attached Supporting Files

Attachments Available to the Yes
Public :

Attached File	Type	Size (MB)
<i>steven.d.murray.pdf</i>	PDF	0.12

June 21, 2013

**VIA E-MAIL AND UNITED STATES
MAIL**

Freedom of Information Officer
U.S. EPA Region 5 (MI-9J)
77 West Jackson Blvd.
Chicago, IL 60604-3590
r5foia@epa.gov

**Re: FOIA Request for Documents Related to Beck's Lake Site, South
Bend, Indiana**

Dear FOIA Officer:

Under the Freedom of Information Act, 5 U.S.C. § 552, I am requesting copies of the following documents relating to the Beck's Lake Site, South Bend, IN, EPA ID No. IND980904379 ("Beck's Lake Site"), docket number EPA-HQ-SFUND-2013-1096:

- Any and all tables of contents or indices of the Headquarters or Regional Superfund Docket for the Beck's Lake Site.
- Any work plans, sampling maps, sampling results and reports of sampling results relating to sampling conducted on or about June 12 and June 1, 2013 in the vicinity of LaSalle Park and/or Beck's Lake or the residential properties located on or near Falcon Street, west of LaSalle Park, South Bend, IN.
- Any and all maps or graphical depictions of locations sampled and reported in the Beck's Lake Site Reassessment Inspection (August 2009).
- Any and all maps or graphical depictions of locations sampled as reported in the Hazard Ranking System (HRS) Documentation Record Cover Sheet (May 2013).
- Pollution Control Systems Inc., 1982, Analytical Results to Mr. Gerald J. Budzin of Bendix, dated February 15, 1982, identified as reference number 7 in the HRS Documentation record Cover Sheet (May 2013).
- IDEM, Reassessment Report for LaSalle Park/Beck's Lake, South Bend, Indiana, March 9, 2007, identified as reference number 10 in the HRS Documentation record Cover Sheet (May 2013).

June 21, 2013

Page 2

- IDEM, Affidavit prepared by Timothy Johnson, State Cleanup Section, IDEM, October 29, 2012, identified as reference number 11 in the HRS Documentation record Cover Sheet (May 2013).
- IDEM, Sampling Work Plan for Expanded Site Assessment prepared by Tim Johnson of IDEM, October 1, 2009, identified as reference number 12 in the HRS Documentation record Cover Sheet (May 2013).
- IDEM, Affidavit prepared by Timothy Johnson, IDEM, February 19, 2013, identified as reference number 13a in the HRS Documentation record Cover Sheet (May 2013).
- IDEM, Arsenic Concentration Map for Beck's Lake, South Bend, Indiana, prepared by Kim Vedder, January 12, 2010, identified as reference number 14 in the HRS Documentation record Cover Sheet (May 2013).
- Weston Solutions Inc., Percent Moisture Calculations performed by Omprakash S. Patel, January 25, 2013, identified as reference number 17 in the HRS Documentation record Cover Sheet (May 2013).
- Weston Solutions Inc., Sample Quantitation Limit Calculations performed by Omprakash S. Patel, January 25, 2013, identified as reference number 17A in the HRS Documentation record Cover Sheet (May 2013).
- Weston Solutions Inc., Map showing 200-foot radius distance from sample locations S6, S8 and S14, October 30, 2012, identified as reference number 21 in the HRS Documentation record Cover Sheet (May 2013).
- IDEM, Letter from Mark Jaworski regarding addresses located on North Falcon Street South Bend, Indiana, with 4-page attachment, identified as reference number 27 in the HRS Documentation record Cover Sheet (May 2013).
- Toeroek Associates, Inc. Letter with attachments to Mike Rafati, U.S. EPA Region 5, Subject: Title Search - Beck's Lake Site, Follow up January 31, 2013, identified as reference number 28 in the HRS Documentation record Cover Sheet (May 2013).
- Weston Solutions Inc., Area Calculation for Source 1 performed by Omprakash S. Patel, March 26, 2013, identified as reference number 29 in the HRS Documentation record Cover Sheet (May 2013).

June 21, 2013

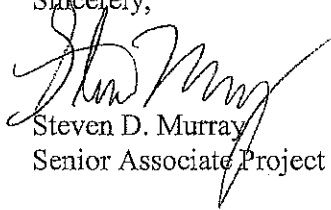
Page 3

Please provide me the documents responsive to this request in an electronic format, such as on CDs or DVDs.

Our fee category is commercial use. If there are any fees for searching or copying the records, please provide an estimate of cost prior to releasing the records. Please contact me as soon as possible with the estimated costs. If the scope of this request is such that you expect unreasonable delay in processing it, please contact me immediately to reach an agreement upon a schedule for responding in installments.

If you deny all or any part of this request, please cite each specific exemption you think justifies your withholding of information. Please also notify me of appeal procedures available under the law. Although a written reply is requested and expected, if you have any questions about handling this request, you may telephone me at 231.922.9050 Ext. 208 or contact me by e-mail at Steven.D.Murray@amec.com.

Sincerely,

A handwritten signature in black ink, appearing to read "Steven D. Murray", written over the printed name and title.

Steven D. Murray
Senior Associate Project Manager

Task DetailsRequest Status : *Closed* Task Due Date : 07/23/2013

Submitted

Evaluation

Assignment

Processing

Request DetailsTracking Number : EPA-R5-
2013-

007584

Requester : Mr.
Steven

D. Murray

Organization : AMEC
Environment and
Infrastructure

Requester Has Account : No

Task DetailsTask Type : Request
DetailAssigned To : Noreen
Weimer
(Superfund Division)Submission Details
Review

Case File

Admin Cost

Assigned Tasks

Comments

Direct URL :

<https://foiaonline.regulations.gov/443/foia/action/public/view/request/80081224>**Case Categorization and Initiation**

Type of Case : FOIA	Received Date :
Fiscal Year : 2013	06/21/2013
Total Days Pending : 19	Clock Initially Started On :
	06/24/2013
	Closed Date :
	07/22/2013

Case Close Out Details

Date Fees Paid :

Final Disposition : Full grant

Records Consultations Correspondence Appeals Invoice

Restricted Materials

Case Responsive RecordsFilter by Title or Keyword(s) :





SUBMIT









CLEAR










Results 50


1 2










75 items found, displaying 1 to 50.








<i>Publish</i>	<i>Title</i>	<i>Type</i>	<i>Exempt</i>	<i>Retention</i>	<i>Action</i>	<i>Detail</i>
	Beck's Lake Index	Microsoft Word	N/A	2 year	Record Has Been Released	
	05-436689	PDF	N/A	2 year	Record Has Been Released	
	05-458821	PDF	N/A	2 year	Record Has Been Released	
	05-905138	PDF	N/A	2 year	Record Has	







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					<i>Been Released</i>	
	05-905139	PDF	N/A	2 year	<i>Record Has Been Released</i>	
	05-905140	PDF	N/A	2 year	<i>Record Has Been Released</i>	
	05-905141	PDF	N/A	2 year	<i>Record Has Been Released</i>	
	05-905142	PDF	N/A	2 year	<i>Record Has Been Released</i>	
	05-905143	PDF	N/A	2 year	<i>Record Has Been Released</i>	
	05-905144	PDF	N/A	2 year	<i>Record Has Been Released</i>	
	05-905145	PDF	N/A	2 year	<i>Record Has Been Released</i>	
	05-905146	PDF	N/A	2 year	<i>Record Has Been Released</i>	

<i>Publish</i>	<i>Title</i>	<i>Type</i>	<i>Exempt</i>	<i>Retention</i>	<i>Action</i>	<i>Detail</i>
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	05-905148	PDF	N/A	2 year	Record Has Been Released	
	05-905149	PDF	N/A	2 year	Record Has Been Released	
	05-289891	PDF	N/A	2 year	Record Has Been Released	
	05-905151	PDF	N/A	2 year	Record Has Been Released	
	05-905152	PDF	N/A	2 year	Record Has Been Released	
	05-905153	PDF	N/A	2 year	Record Has Been Released	
	05-905154	PDF	N/A	2 year	Record Has Been Released	
	05-905155	PDF	N/A	2 year	Record Has	

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	05-905157	PDF	N/A	2 year	Record Has Been Released	
	05-905158	PDF	N/A	2 year	Record Has Been Released	
	05-905159	PDF	N/A	2 year	Record Has Been Released	
	05-905160	PDF	N/A	2 year	Record Has Been Released	
	05-905161	PDF	N/A	2 year	Record Has Been Released	
	05-905162	PDF	N/A	2 year	Record Has Been Released	
	05-905163	Microsoft Excel	N/A	2 year	Record Has Been Released	

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	05-905165	PDF	N/A	2 year	Record Has Been Released	
	05-905166	PDF	N/A	2 year	Record Has Been Released	
	05-905167	PDF	N/A	2 year	Record Has Been Released	
	05-905168	PDF	N/A	2 year	Record Has Been Released	
	05-905169	PDF	N/A	2 year	Record Has Been Released	
	05-905170	PDF	N/A	2 year	Record Has	

<i>Publish</i>	<i>Title</i>	<i>Type</i>	<i>Exempt</i>	<i>Retention</i>	<i>Action</i>	<i>Detail</i>
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	05-458821	PDF	N/A	2 year	Record Has Been Released	
	05-905138	PDF	N/A	2 year	Record Has Been Released	
	05-905139	PDF	N/A	2 year	Record Has Been Released	
	05-905140	PDF	N/A	2 year	Record Has Been Released	
	05-905141	PDF	N/A	2 year	Record Has Been Released	
	05-905142	PDF	N/A	2 year	Record Has Been Released	
	05-905143	PDF	N/A	2 year	Record Has Been Released	

<i>Publish</i>	<i>Title</i>	<i>Type</i>	<i>Exempt</i>	<i>Retention</i>	<i>Action</i>	<i>Detail</i>
	05-905144	PDF	N/A	2 year	Record Has Been Released	
	05-905145	PDF	N/A	2 year	Record Has Been Released	
	05-905146	PDF	N/A	2 year	Record Has Been Released	
	05-905147	PDF	N/A	2 year	Record Has Been Released	
75 items found, displaying 1 to 50.						<div><div>1</div><div>2</div><div></div><div></div></div>

EPA-R5-2013-007584

6/24/13 – Received FOIA

6/26/13 – Ran off SEMS and checked the documents responsive.

7/1/13 – Put in Retrieval to make sure everything is in SEMS, checking for 2013 documents (form in file). Sent email to Mary Fulghrum with a copy of the FOIA and the SEMS list (email in file).

7/8/13 – Sent email to Owen Thompson to find out if he had anything for Bullets 2-4 (email in file). Received email from Owen that he got the test results in last week, need to check with Mary to see if they are releasable (email in file).

7/9/13 – Received email from Mary that we need to let the requestor know estimated amount of money, would go over the \$25.00 amount. Also she will look over the new sampling report from Owen for bullet #2, bullet 3 she doesn't have any information but check for addresses and names to be redacted (email in file).

7/10/13 – Received email from Owen that he will give the sampling data to Mary to look over to see if releasable, had information for bullet #3 which I have and to check with site assessment for bullets 3 and 4 (email in file).

7/11/13 – Sent email to Owen thanking him for the information and that #436629 I couldn't find which was the IDEM ESI2 Report but that I found it on the SEMS list under #436689 which was the IDEM Expanded Site Inspection 2 Report and that I will ask site assessment if they have anything for bullets 3 and 4 (email in file). Sent email to Mary/Owen that I need an estimate from them so I can let the requestor know an estimate amount (email in file). Forwarded the email from Owen to Pat/Nuria/David and Erica, explained that both Nuria and Pat are out and if they could help out or do they want me to wait until Pat gets back (email in file). Received email from Mary that she has worked ½ already and may spend another ½ hour, for a total of 1 hour (email in file). Received email from Owen that the #436689 was the right document (email in file). Received email from Owen that he has spent ½ hour so far and probably spend another ½ hour with Site Assessment People for a total of 1 hour (email in file). Sent email to the requestor that the cost to respond would be over the \$25.00 and gave him an estimate of \$200.00 and that if it would happen to be more I would let him know (email in file). Received email from the requestor giving the OK for the \$200.00 fee commitment (email in file). Received email from Erica and suggested that I give Document ID #'s 905138-905171 (email in file). Sent email to Erica thanking her and asked for her time spent (email in file).

7/16/13 – Sent email to both Owen and Mary and let them know I have everything except for the sampling data and to let me know if this is releasable or not (email in file). Received email from Owen that he is sure it is releasable since they put it on the Beck's Lake EPA website (email in

file). Sent email to Owen and Mary saying thanks and that I will put it in for scanning as releasable (email in file). Put the sampling data that Owen sent with the email into the Records Center to be scanned, once scanned then I can do the response.

7/18/13 – Jeff Doerr was calling for the requestor, the requestor was out of the office, he wanted to know an update on the FOIA. I told Mr. Doerr that the letter was in the being put through the process of reviewing the letter and that when it was done, I would upload the documents to our system and the requestor would be getting an email with an Internet Link to receive the documents. I also told him that the requestor gave a \$200.00 fee commitment but it only costed \$77.00.

SRC-7J

Steven D. Murray
AMEC Environment and Infrastructure
41 Hughes Drive
Traverse City, Michigan 49696

Re: Freedom of Information Act
FOI Number: EPA-R5-2013-007584
Site(s): Beck's Lake Site, South Bend, Indiana

Dear Mr. Murray:

This letter serves as the Superfund Division's response to your Freedom of Information Act (FOIA) request to the U. S. Environmental Protection Agency dated June 21, 2013.

The Superfund Division will be providing the responsive documents to your FOIA request through the FOIA On-Line system. You will receive a final disposition notice from the Region 5 FOIA Office that will provide you with an Internet link to access the disclosed documents. An enclosed index of the responsive documents granted by the Superfund Division is included with this letter.

You will receive an invoice from the Region 5 FOIA Office in the amount of \$77.00 that covers the cost of search, review, and any duplication of responsive documents. The charges were confirmed on July 18, 2013.

Superfund public dockets and Administrative Records may be obtained at the Superfund Record Center located at the EPA office in Room 714. The Record Center is open to the public Monday through Friday 8:00 am to 4:00 pm.

You may appeal this response to the National Freedom of Information Officer, U.S. EPA, FOIA and Privacy Branch, 1200 Pennsylvania Avenue, N.W. (2822T), Washington, DC 20460 (U.S. Postal Service Only), FAX: (202) 566-2147, E-mail: hq.foia@epa.gov. Only items mailed through the United States Postal Service may be delivered to 1200 Pennsylvania Avenue, NW. If you are submitting your appeal via hand delivery, courier service or overnight delivery, you must address your correspondence to 1301 Constitution Avenue, N.W., Room 6416J, Washington, DC 20004. Your appeal must be made in writing, and it

must be submitted no later than 30 calendar days from the date of this letter. The Agency will not consider appeals received after the 30 calendar day limit. The appeal letter should include the request number EPA-R5-2013-007584. For quickest possible handling, the appeal letter and its envelope should be marked "Freedom of Information Act Appeal."

Should you have questions regarding your FOIA request, you may contact me at (312) 353-8655. All other matters should be directed to Evette Jones, Chief, Enforcement Services Section #3 at (312) 886-7572.

Sincerely,

Noreen Weimer
Freedom of Information Act Specialist
Enforcement Services Section #3
Superfund Division

Enclosures

cc: Region 5 FOIA Office, MRI-9J
FOIA File

DOCUMENTS TO THE REQUESTOR

Please see the attached document list for the record(s) that have been uploaded to our FOIA Online System.

Attachment 2

***Element Concentrations in Soils and Other Surficial
Materials of the Conterminous United States, U. S.
Geological Survey Professional Paper 1270, Shacklette and
Boerngen, 1984***

Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States

U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 1270



Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States

By HANSFORD T. SHACKLETTE and JOSEPHINE G. BOERNGEN

U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 1270

*An account of the concentrations of
50 chemical elements in samples of
soils and other regoliths*



UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1984

UNITED STATES DEPARTMENT OF THE INTERIOR

WILLIAM P. CLARK, *Secretary*

GEOLOGICAL SURVEY

Dallas L. Peck, *Director*

Library of Congress Cataloging in Publication Data

Shacklette, Hansford T.

Element concentrations in soils and other surficial materials of the conterminous United States.
(Geological Survey professional paper ; 1270)

Bibliography: 105 p.

Supt. of Docs. No.: I 19.16

1. Soils—United States—Composition.

I.	Boerngen, Josephine G.	II.	Title.	III.	Series
			S599.A1S5		631.4"7"73 82-600084

AACR2

For sale by the Distribution Branch, U.S. Geological Survey,
604 South Pickett Street, Alexandria, VA 22304

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Introduction	1
Acknowledgments	2
Review of literature	2
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Sampling media	5
Chemical-analysis procedures	5
Data presentation	5
Discussion of results	7
References cited	9

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4. Arsenic	18
5. Barium	20
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ELEMENT CONCENTRATIONS IN SOILS AND OTHER SURFICIAL MATERIALS OF THE CONTERMINOUS UNITED STATES

By HANSFORD T. SHACKLETTE and JOSEPHINE G. BOERNGEN

ABSTRACT

Samples of soils or other regoliths, taken at a depth of approximately 20 cm from locations about 80 km apart throughout the conterminous United States, were analyzed for their content of elements. In this manner, 1,318 sampling sites were chosen, and the results of the sample analyses for 50 elements were plotted on maps. The arithmetic and geometric mean, the geometric deviation, and a histogram showing frequencies of analytical values are given for 47 elements.

The lower concentrations of some elements (notably, aluminum, barium, calcium, magnesium, potassium, sodium, and strontium) in most samples of surficial materials from the Eastern United States, and the greater abundance of heavy metals in the same materials of the Western United States, indicates a regional geochemical pattern of the largest scale. The low concentrations of many elements in soils characterize the Atlantic Coastal Plain. Soils of the Pacific Northwest generally have high concentrations of aluminum, cobalt, iron, scandium, and vanadium, but are low in boron. Soils of the Rocky Mountain region tend to have high concentrations of copper, lead, and zinc. High mercury concentrations in surficial materials are characteristic of Gulf Coast sampling sites and the Atlantic coast sites of Connecticut, Massachusetts, and Maine. At the State level, Florida has the most striking geochemical pattern by having soils that are low in the concentrations of most elements considered in this study. Some smaller patterns of element abundance can be noted, but the degree of confidence in the validity of these patterns decreases as the patterns become less extensive.

INTRODUCTION

The abundance of certain elements in soils and other surficial materials is determined not only by the element content of the bedrock or other deposits from which the materials originated, but also by the effects of climatic and biological factors as well as by influences of agricultural and industrial operations that have acted on the materials for various periods of time. The diversity of these factors in a large area is expected to result in a corresponding diversity in the element contents of the surficial materials.

At the beginning of this study (1961), few data were available on the abundance of elements in surficial materials of the United States as a whole. Most of the early reports discussed only the elements that were of economic importance to mining or agriculture in a

metallogenic area or State; and the data, for the most part, cannot be evaluated with reference to average, or normal, amounts in undisturbed materials because they were based on samples of deposits expected to have anomalous amounts of certain elements, or were based only on samples from cultivated fields.

We began a sampling program in 1961 that was designed to give estimates of the range of element abundance in surficial materials that were unaltered or very little altered from their natural condition, and in plants that grew on these deposits, throughout the conterminous United States. We believed that analyses of the surficial materials would provide a measure of the total concentrations of the elements that were present at the sampling sites, and that analysis of the plants would give an estimate of the relative concentrations among sites of the elements that existed in a chemical form that was available to plants. Because of the great amount of travel necessary to complete this sampling, we asked geologists and others of the U.S. Geological Survey to assist by collecting samples when traveling to and from their project areas and to contribute appropriate data they may have collected for other purposes. The response to this request, together with the samples and data that we had collected, resulted in our obtaining samples of surficial materials and plants from 863 sites. The analyses of surficial materials sampled in this phase of the study were published for 35 elements by plotting element concentrations, in two to five frequency classes, on maps (Shacklette, Hamilton, and others, 1971).

Soon after the publication of the results of this study, interest in environmental matters, particularly in the effects of contamination and industrial pollution, increased greatly. At the same time, technological advances in analytical methods and data processing facilitated measurements of geochemical and other parameters of the environment. In response to the need for background data for concentrations of certain elements of particular environmental concern, the samples of surficial materials that were collected for the first study (Shacklette, Hamilton, and others, 1971) (with some ad-

ditional samples) were analyzed for other elements, and the results were published in U.S. Geological Survey Circulars: for mercury, Shacklette, Boerngen, and Turner (1971); for lithium and cadmium, by Shacklette, and others (1973); and for selenium, fluorine, and arsenic, Shacklette and others (1974).

The collection of samples for this study continued, as opportunities arose, until autumn 1975, resulting in the sampling of an additional 355 sites that were selected to give a more uniform geographical coverage of the conterminous United States. This sampling continuation is referred to as phase two. These samples were analyzed, and the data were merged with those of the original samples to produce the results given in the present report. In addition, the availability of analytical methods for elements not included in the earlier reports permitted data to be given on these elements in the more recently collected samples.

The collection localities and dates, sample descriptions, and analytical values for each sample in the present report were published by Boerngen and Shacklette (1981). The elemental compositions of only the surficial materials are given in this report; the data on analyses of the plant samples are held in files of the U.S. Geological Survey.

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REVIEW OF LITERATURE

The literature on the chemical analysis of soils and other surficial materials in the United States is extensive and deals largely with specific agricultural problems of regional interest. Many of the papers were written by soil scientists and chemists associated with State agricultural experiment stations and colleges of agriculture, and most reports considered only elements that were known to be nutritive or toxic to plants or animals.

Chemists with the U.S. Department of Agriculture prepared most early reports of element abundance in soils for large areas of the United States. (See Robinson, 1914; Robinson and others, 1917). The 1938 yearbook of agriculture was devoted to reports on soils of the United States; in this book, McMurtrey and Robinson (1938) discussed the importance and abundance of trace elements in soils. Amounts of the major elements in soil samples from a few soil profiles distributed throughout the United States were compiled by the soil scientist C. F. Marbut (1935) to illustrate characteristics of soil units.

The use of soil analysis in geochemical prospecting began in this country in the 1940's, and many reports were published on the element amounts in soils from areas where mineral deposits were known or suspected to occur. Most of these reports included only a few elements in soils from small areas. This early geochemical work was discussed by Webb (1953) and by Hawkes (1957). In succeeding years, as soil analyses became an accepted method of prospecting and as analytical

methods were improved, many elements in soils were analyzed; still, the areas studied were commonly small.

An estimate of the amounts of elements in average, or normal, soils is useful in appraising the amounts of elements in a soil sample as related to agricultural, mineral prospecting, environmental quality, and health and disease investigations. Swaine (1955) gave an extensive bibliography of trace-element reports on soils of the world, and he also summarized reports of the average amounts of elements as given by several investigators. The most comprehensive list of average amounts of rare and dispersed elements in soils is that of Vinogradov (1959), who reported the analytical results of extensive studies of soils in the Union of Soviet Socialist Republics, as well as analyses of soils from other countries. He did not state the basis upon which he established the average values; however, these values are presumably the arithmetic means of element amounts in samples from throughout the world. In their discussions of the principles of geochemistry, Goldschmidt (1954) and Rankama and Sahama (1955) reported the amounts of various elements present in soils and in other surficial materials, Hawks and Webb (1962) and, more recently, Brooks (1972), Siegal (1974), Levinson (1974), and Rose and others (1979) gave average amounts of certain elements in soils as useful guides in mineral exploration.

A report on the chemical characteristics of soils was edited by Bear (1964). In this book, the chapter on chemical composition of soils by Jackson (1964) and the chapter on trace elements in soils by Mitchell (1964) gave the ranges in values or the average amounts of some soil elements.

Regional geochemical studies conducted by scientists of the U.S. Geological Survey within the past two decades have been largely directed to the establishment of baseline abundances of elements in surficial materials, including soils. Most of the earlier work investigated these materials that occurred in their natural condition, having little or no alterations that related to human activities, with the objective of establishing normal element concentrations in the materials by which anomalous concentrations, both natural or man induced, could be judged. Some of these studies were conducted in cooperation with medical investigators who were searching for possible relationships of epidemiological patterns to characteristics of the environment. In one study, the geochemical characteristics of both natural and cultivated soils were determined in two areas of Georgia that had contrasting rates of cardiovascular diseases (Shacklette and others, 1970). In an extensive geochemical study of Missouri, also conducted cooperatively with medical researchers, both cultivated and natural soils were sampled. The results were presented for the State as a whole, and for physiographic regions

or other subdivisions and smaller areas, as follows: Erdman and others (1976a, 1976b); Tidball (1976, 1983a, 1983b); and Ebens and others (1973). The results of these studies, and of other regional geochemical investigations, were summarized and tabulated by Connor and Shacklette (1975).

Recent regional studies of soil geochemistry by the U.S. Geological Survey related to the development of energy resources in the western part of the United States, including North Dakota, South Dakota, Montana, Wyoming, Colorado, Utah, and New Mexico. These studies established regional geochemical baselines for soils, both in undisturbed areas and in areas that had been altered by mining and related activities. Some of these studies considered the elements in soils both as total concentrations and as concentrations that were available to plants of the region. The results of these studies were published in annual progress reports (U.S. Geological Survey, 1974, 1975, 1976, 1977, and 1978). The data on soils, as well as on other natural materials, in these reports were summarized and tabulated by Ebens and Shacklette (1981). In a study of the elements in fruits and vegetables from 11 areas of commercial production in the United States, and in the soils on which this produce grew, soils were analyzed for 39 elements, as reported by Boerngen and Shacklette (1980) and Shacklette (1980).

The average amounts of elements in soils and other surficial materials of the United States, as determined in the present study, are given in table 1, with the average values or ranges in values that were reported by Vinogradov (1959), Rose and others (1979), Jackson (1964), Mitchell (1964), and Brooks (1972). The averages from the present study given in table 1 are the arithmetic means. Although the averages were computed by the methods described by Miesch (1967), the values obtained are directly comparable with the arithmetic means derived by common computational procedures.

COLLECTION AND ANALYSIS OF GEOCHEMICAL DATA

SAMPLING PLAN

The sampling plan was designed with the emphasis on practicality, in keeping with the expenditures of time and funds available, and its variance from an ideal plan has been recognized from the beginning. Because the collection of most samples was, by necessity, incidental to other duties of the samplers, the instructions for sampling were simplified as much as possible, so that sampling methods would be consistent within the wide range of kinds of sites to be sampled. The samples were

ELEMENT CONCENTRATIONS IN SOILS, CONTERMINOUS UNITED STATES

TABLE 1.—Average or median contents, and range in contents, reported for elements in soils and other surficial materials

[Data are in parts per million; each average represents arithmetic mean; leaders (—) in figure columns indicate no data available. A, average; M, median. <, less than; >, greater than]

Element	This report		Rose, and others (1979) (elements useful in geochemical prospecting)	Vinogradov (1959) (presumably, averages from worldwide sampling)	Jackson (1964) "Typical", ¹ average, or range in values	Mitchell (1964) Range in contents in Scottish sur- face soils	Brooks (1972) Average or range
	Average	Range					
Al-----	72,000	700 - 10,000	-----	71,300	10,000 - 60,000	-----	-----
As-----	7.2	<0.1 - 97	7.5 (M)	5	-----	-----	5
B-----	33	<20 - 300	29 (M)	10	30	-----	10
Ba-----	580	10 - 5,000	300 (M)	-----	-----	400 - 3,000	500
Be-----	.92	<1 - 15	0.5 - 4	6	-----	<5 - 5	6
Br-----	.85	<0.5 - 11	-----	5	-----	-----	-----
C, total	25,000	600 - 370,000	-----	20,000	-----	-----	-----
Ca-----	24,000	100 - 320,000	-----	13,700	7,000	-----	-----
Ce-----	75	<150 - 300	-----	-----	-----	-----	-----
Co-----	9.1	<3 - 70	10 (M)	8	-----	<2 - 80	10
Cr-----	54	1 - 2,000	6.3 (M)	200	-----	5 - 3,000	200
Cu-----	25	<1 - 700	15 (M)	20	20	<10 - 100	20
F-----	430	<10 - 3,700	300 (M)	200	-----	-----	-----
Fe-----	26,000	100 - >100,000	21,000 (M)	38,000	7,000 - 42,000	-----	10,000 - 50,000
Ga-----	17	<5 - 70	-----	30	-----	15 - 70	20
Ge-----	1.2	<0.1 - 2.5	-----	1	-----	-----	5
Hg-----	.09	<0.01 - 4.6	0.056 (M)	-----	-----	-----	.01
I-----	1.2	<0.5 - 9.6	-----	-----	-----	-----	-----
K-----	15,000	50 - 63,000	11,000 (M)	13,600	400 - 28,000	-----	-----
La-----	37	<30 - 200	-----	-----	-----	<30 - 200	-----
Li-----	24	<5 - 140	6.2 (M)	30	-----	-----	30
Mg-----	9,000	50 - >100,000	-----	6,300	<6,000	-----	-----
Mn-----	550	<2 - 7,000	320 (M)	850	-----	200 - 5,000	850
Mo-----	.97	<3 - 15	2.5 (A)	2	-----	<1 - 5	2.5
Na-----	12,000	<500 - 100,000	-----	6,300	-----	-----	-----
Nb-----	11	<10 - 100	15 (A)	-----	-----	-----	15
Nd-----	46	<70 - 300	-----	-----	-----	-----	-----
Ni-----	19	<5 - 700	17 (M)	40	-----	10 - 800	40
P-----	430	<20 - 6,800	300 (M)	800	500	-----	-----
Pb-----	19	<10 - 700	17 (M)	-----	-----	<20 - 80	10
Rb-----	67	<20 - 210	35 (M)	100	-----	-----	-----
S, total	1,600	<800 - 48,000	100 - 2,000	850	-----	-----	-----
Sb-----	.66	<1 - 8.8	2 (A)	-----	-----	-----	.5
Sc-----	8.9	<5 - 50	-----	7	-----	<3 - 15	-----
Se-----	.39	<0.1 - 4.3	0.31 (M)	.001	-----	-----	.5
Si-----	310,000	16,000 - 450,000	-----	330,000	-----	-----	-----
Sn-----	1.3	<0.1 - 10	10 (A)	-----	-----	-----	10
Sr-----	240	<5 - 3,000	67 (M)	300	-----	60 - 700	300
Ti-----	2,900	70 - 20,000	-----	4,600	1,200 - 6,000	-----	-----
Th-----	9.4	2.2 - 31	-----	-----	-----	-----	13
U-----	2.7	0.29 - 11	1 (A)	-----	-----	-----	1
V-----	80	<7 - 500	57 (M)	100	-----	20 - 250	100
Y-----	25	<10 - 200	-----	50	-----	25 - 100	-----
Yb-----	3.1	<1 - 50	-----	-----	-----	-----	-----
Zn-----	60	<5 - 2,900	36 (M)	50	-----	-----	50
Zr-----	230	<20 - 2,000	270 (M)	300	-----	200 - >1,000	-----

¹Author's usage; generally used to indicate the most commonly occurring value.

collected by U.S. Geological Survey personnel along their routes of travel to areas of other types of field studies or within their project areas.

The locations of the routes that were sampled depended on both the network of roads that existed and the destinations of the samplers. Sampling intensity was kept at a minimum by selecting only one sampling site every 80 km (about 50 miles; selected for convenience because vehicle odometers were calibrated in miles) along the routes. The specific sampling sites

were selected, insofar as possible, that had surficial materials that were very little altered from their natural condition and that supported native plants suitable for sampling. In practice, this site selection necessitated sampling away from roadcuts and fills. In some areas, only cultivated fields and plants were available for sampling.

Contamination of the sampling sites by vehicular emissions was seemingly insignificant, even though many sites were within 100 m or less of the roads. Col-

lecting samples at about 20 cm depth, rather than at the upper soil horizons, may have avoided the effects of surface contamination on the samples. However, we had no adequate way of measuring any contamination that may have occurred. (See Cannon and Bowles, 1962.) Many of the sampled routes had only light vehicular traffic, and some were new interstate highways. Routes through congested areas generally were not sampled; therefore, no gross contamination of the samples was expected.

The study areas that were sampled follow: Wisconsin and parts of contiguous States, southeastern Missouri, Georgia, and Kentucky, sampled by Shacklette; Kentucky, sampled by J. J. Connor and R. R. Tidball; Nevada, New Mexico, and Maryland, sampled by H. L. Cannon; various locations in Arizona, Colorado, Montana, New Mexico, Utah, and Wyoming, sampled by F. A. Branson and R. F. Miller; Missouri, sampled by Shacklette, J. A. Erdman, J. R. Keith, and R. R. Tidball; and various locations in Colorado, Idaho, Montana, South Dakota, Utah, and Wyoming, sampled by A. T. Miesch and J. J. Connor. Sampling techniques used in these areas varied according to the primary objectives of the studies being conducted, but generally these techniques were closely similar to the methods used in sampling along the roads.

In general, the sampling within study areas was more intensive than that along the travel routes. To make the sampling intensity of the two sampling programs more nearly equal, only the samples from selected sites in the study areas were used for this report. The selected sites were approximately 80 km apart. Where two or more samples were collected from one site, they were assigned numbers, and one of these samples was randomly chosen for evaluation in this study.

SAMPLING MEDIA

The material sampled at most sites could be termed "soil" because it was a mixture of comminuted rock and organic matter, it supported ordinary land plants, and it doubtless contained a rich microbiota. Some of the sampled deposits, however, were not soils as defined above, but were other kinds of regoliths. The regoliths included desert sands, sand dunes, some loess deposits, and beach and alluvial deposits that contained little or no visible organic matter. In some places the distinctions between soils and other regoliths are vague because the materials of the deposits are transitional between the two. Samples were collected from a few deposits consisting mostly of organic materials that would ordinarily be classified as peat, rather than soil.

To unify sampling techniques, the samplers were asked to collect the samples at a depth of approximately 20 cm below the surface of the deposits. This depth

was chosen as our estimate of a depth below the plow zone that would include parts of the zone of illuviation in most well-developed zonal soils, and as a convenient depth for sampling other surficial materials. Where the thickness of the material was less than 20 cm, as in shallow soils over bedrock or in lithosols over large rock fragments, samples were taken of the material that lay just above the rock deposits. About 0.25 liter of this material was collected, put in a kraft paper envelope, and shipped to the U.S. Geological Survey laboratories in Denver, Colo.

CHEMICAL-ANALYSIS PROCEDURES

The soil samples were oven dried in the laboratory and then sifted through a 2-mm sieve. If the soil material would not pass this sieve, the sample was pulverized in a ceramic mill before sieving. Finally, the sifted, minus 2-mm fraction of the sample was used for analysis.

The methods of analysis used for some elements were changed during the course of this study, as new techniques and instruments became available. For most elements, the results published in the first report (Shacklette, Hamilton, and others, 1971) were obtained by use of a semiquantitative six-step emission spectrographic method (Meyers and others, 1961). The methods used for other elements were: EDTA titration for calcium; colorimetric (Ward and others, 1963) for phosphorus and zinc; and flame photometry for potassium. Many of the elements analyzed in the 355 samples collected in phase two of the study were also analyzed by the emission spectrographic method (Neiman, 1976). Other methods were used for the following elements: flame atomic absorption (Huffman and Dinnin, 1976) for mercury, lithium, magnesium, sodium, rubidium, and zinc; flameless atomic absorption (Vaughn, 1967) for mercury; X-ray fluorescence spectrometry (Wahlberg, 1976) for calcium, germanium, iron, potassium, selenium, silver, sulfur, and titanium; combustion (Huffman and Dinnin, 1976) for total carbon; and neutron activation (Millard, 1975, 1976) for thorium and uranium.

DATA PRESENTATION

Summary data for 46 elements are reported in tables 1 and 2. In table 1, the element concentrations found in samples of soil and other surficial materials of this study are compared with those in soils reported in other studies. Arithmetic means are used for the data of this study to make them more readily compared with the data generally reported in the literature. These arithmetic means were derived from the estimated geometric means by using a technique described by Miesch (1967), which is based on methods devised by Cohen (1959) and Sichel (1952). The arithmetic means in table

1, unlike the geometric means shown in table 2, are estimates of geochemical abundance (Miesch, 1967). Arithmetic means are always larger than corresponding geometric means (Miesch, 1967, p. B1) and are estimates of the fractional part of a single specimen that consists of the element of concern rather than of the typical concentration of the element in a suite of samples.

Concentrations of 46 elements in samples of this study are presented in table 2, which gives the determination ratios, geometric-mean concentrations and deviations, and observed ranges in concentrations. The analytical data for most elements as received from the laboratories were transformed into logarithms because of the tendency for elements in natural materials, particularly the trace elements, to have positively skewed

TABLE 2.—Mean concentrations, deviations, and ranges of elements in samples of soils and other surficial materials in the conterminous United States

[Means and ranges are reported in parts per million ($\mu\text{g/g}$), and means and deviations are geometric except as indicated. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. <, less than; >, greater than]

Element	Conterminous United States				Western United States (west of 96th meridian)				Eastern United States (east of 96th meridian)				
	Mean	Devia- tion	Estimated arithmetic mean	Ratio	Mean	Devia- tion	Observed range	Estimated arithmetic mean	Ratio	Mean	Devia- tion	Observed range	Estimated arithmetic mean
Al, percent	4.7	2.48	7.2	661:770	5.8	2.00	0.5 - >10	7.4	450:477	3.3	2.87	0.7 - >10	5.7
As-----	5.2	2.23	7.2	728:730	5.5	1.98	<0.10 - 97	7.0	521:527	4.8	2.56	<0.1 - 73	7.4
B-----	26	1.97	33	506:778	23	1.99	<20 - 300	29	425:541	31	1.88	<20 - 150	38
Ba-----	440	2.14	580	778:778	580	1.72	70 - 5,000	670	541:541	290	2.35	10 - 1,500	420
Be-----	.63	2.38	.92	310:778	.68	2.30	<1 - 15	.97	169:525	.55	2.53	<1 - 7	.85
Br-----	.56	2.50	.85	113:220	.52	2.74	<0.5 - 11	.86	78:128	.62	2.18	<0.5 - 5.3	.85
C, percent	1.6	2.57	2.5	250:250	1.7	2.37	0.16 - 10	2.5	162:162	1.5	2.88	0.06 - 37	2.6
Ca, percent	.92	4.00	2.4	777:777	1.8	3.05	0.06 - 32	3.3	514:514	.34	3.08	0.01 - 28	.63
Ce-----	63	1.78	75	81:683	65	1.71	<150 - 300	75	70:489	63	1.85	<150 - 300	76
Co-----	6.7	2.19	9.1	698:778	7.1	1.97	<3 - 50	9.0	403:533	5.9	2.57	<0.3 - 70	9.2
Cr-----	37	2.37	54	778:778	41	2.19	3 - 2,000	56	541:541	33	2.60	1 - 1,000	52
Cu-----	17	2.44	25	778:778	21	2.07	2 - 300	27	523:533	13	2.80	<1 - 700	22
F-----	210	3.34	430	598:610	280	2.52	<10 - 1,900	440	390:435	130	4.19	<10 - 3,700	360
Fe, percent	1.8	2.38	2.6	776:777	2.1	1.95	0.1 - >10	2.6	539:540	1.4	2.87	0.01 - >10	2.5
Ga-----	13	2.03	17	767:776	16	1.68	<5 - 70	19	431:540	9.3	2.38	<5 - 70	14
Ge-----	1.2	1.37	1.2	224:224	1.2	1.32	0.58 - 2.5	1.2	130:131	1.1	1.45	<0.1 - 2.0	1.2
Hg-----	.058	2.52	.089	729:733	.046	2.33	<0.01 - 4.6	.065	534:534	.081	2.52	0.01 - 3.4	.12
I-----	.75	2.63	1.2	169:246	.79	2.55	<0.5 - 9.6	1.2	90:153	.68	2.81	<0.5 - 7.0	1.2
K, percent ¹	1.5	.79	None	777:777	1.8	.71	0.19 - 6.3	None	537:537	1.2	1.75	0.005 - 3.7	--
La-----	30	1.92	37	462:777	30	1.89	<30 - 200	37	294:516	29	1.98	<30 - 200	37
Li-----	20	1.85	24	731:731	22	1.58	5 - 130	25	479:527	17	2.16	<5 - 140	22
Mg, percent	.44	3.28	.90	777:778	.74	2.21	0.03 - >10	1.0	528:528	.21	3.55	0.005 - 5	.46
Mn-----	330	2.77	550	777:777	380	1.98	30 - 5,000	480	537:540	260	3.82	<2 - 7,000	640
Mo-----	.59	2.72	.97	57:774	.85	2.17	<3 - 7	1.1	32:524	.32	3.93	<3 - 15	.79
Na, percent	.59	3.27	1.2	744:744	.97	1.95	0.05 - 10	1.2	363:449	.25	4.55	<0.05 - 5	.78
Nb-----	9.3	1.75	11	418:771	8.7	1.82	<10 - 100	10	322:498	10	1.65	<10 - 50	12
Nd-----	40	1.68	46	120:538	36	1.76	<70 - 300	43	109:332	46	1.58	<70 - 300	51
Ni-----	13	2.31	19	747:778	15	2.10	<5 - 700	19	443:540	11	2.64	<5 - 700	18
P-----	260	2.67	430	524:524	120	2.33	40 - 4,500	460	380:382	200	2.95	<20 - 6,800	360
Pb-----	16	1.86	19	712:778	17	1.80	<10 - 700	20	422:541	14	1.95	<10 - 300	17
Rb-----	58	1.72	67	221:224	69	1.50	<20 - 210	74	107:131	43	1.94	<20 - 160	53
S, percent	.12	2.04	.16	34:224	.13	2.37	<0.08 - 4.8	.19	20:131	.10	1.34	<0.08 - 0.31	.11
Sb-----	.48	2.27	.67	35:223	.47	2.15	<1 - 2.6	.62	31:131	.52	2.38	<1 - 8.8	.76
Sc-----	7.5	1.82	8.9	685:778	8.2	1.74	<5 - 50	9.6	389:526	6.5	1.90	<5 - 30	8.0
Se-----	.26	2.46	.39	590:733	.23	2.43	<0.1 - 4.3	.34	449:534	.30	2.44	<0.1 - 3.9	.45
Si, percent ¹	31	6.48	None	250:250	30	5.70	15 - 44	None	156:156	34	6.64	1.7 - 45	--
Sn-----	.89	2.36	1.3	218:224	.90	2.11	<0.1 - 7.4	1.2	123:131	.86	2.81	<0.1 - 10	1.5
St-----	120	3.30	240	778:778	100	2.16	10 - 3,000	270	501:540	53	3.61	<5 - 700	120
Ti, percent	.24	1.89	.29	777:777	.22	1.78	0.05 - 2.0	.26	540:540	.28	2.00	0.007 - 1.5	.35
Th-----	8.6	1.53	9.4	195:195	9.1	1.49	2.4 - 31	9.8	102:102	7.7	1.58	2.2 - 23	8.6
U-----	2.3	1.73	2.7	224:224	2.5	1.45	0.68 - 7.9	2.7	130:130	2.1	2.12	0.29 - 11	2.7
V-----	58	2.25	80	778:778	70	1.95	7 - 500	88	516:541	43	2.51	<7 - 300	66
Y-----	21	1.78	25	759:778	22	1.66	<10 - 150	25	477:541	20	1.97	<10 - 200	25
Yb-----	2.6	1.79	3.1	754:764	2.6	1.63	<1 - 20	3.0	452:486	2.6	2.06	<1 - 50	3.3
Zn-----	48	1.95	60	766:766	55	1.79	10 - 2,100	65	473:482	40	2.11	<5 - 2,900	52
Zr-----	180	1.91	230	777:778	160	1.77	<20 - 1,500	190	539:541	220	2.01	<20 - 2,000	290

¹Means are arithmetic, deviations are standard.

frequency distributions. For this reason, the geometric mean is the more proper measure of central tendency for these elements. The frequency distributions for potassium and silicon, on the other hand, are more nearly normal if the data are not transformed to logarithms and the mean is expressed as the arithmetic average.

In geochemical background studies, the magnitude of scatter to be expected around the mean is as important as the mean. In lognormal distributions, the geometric deviation measures this scatter, and this deviation may be used to estimate the range of variation expected for an element in the material being studied. About 68 percent of the samples in a randomly selected suite should fall within the limits M/D and $M \cdot D$, where M represents the geometric mean and D the geometric deviation. About 95 percent should fall between M/D^2 and $M \cdot D^2$, and about 99.7 percent between M/D^3 and $M \cdot D^3$.

The analytical data for some elements include values that are below, or above, the limits of numerical determination, and these values are expressed as less than (<) or greater than (>) a stated value. These data are said to be censored, and for these the mean was computed by using a technique described by Cohen (1959) and applied to geochemical studies by Miesch (1967). This technique requires an adjustment of the summary statistics computed for the noncensored part of the data. The censoring may be so severe in certain sets of data that a reliable adjustment cannot be made; with the data sets used in the present study, however, no such circumstances were encountered. The use of these procedures in censored data to quantify the central tendency may result in estimates of the mean that are lower than the limit of determination. For example, in table 2 the geometric-mean molybdenum concentration in soils from the Eastern United States is estimated to be 0.32 ppm, although the lower limit of determination of the analytical method that was used is 3 ppm. Use of this procedure permits inclusion of the censored values in the calculation of expected mean concentrations.

The determination ratios in table 2—that is, the ratio of the number of samples in which the element was found in measurable concentrations to the total number of samples—permit the number of censored values, if any, to be found that were used in calculating the mean. This number is found by subtracting the left value in the ratio from the right.

The distribution of the sampling sites and the concentrations of elements determined for samples from the sites are presented on maps of the conterminous United States (figs. 1–47). Figure 1 shows the locations of sites where four elements, bismuth, cadmium, praseodymium, and silver, were found in the samples. These elements were determined too uncommonly for reliable

mean concentrations to be calculated. Each of the remaining maps (figs. 2–47) gives the locations where an element was found in a sample from a site and the concentration of the element, shown by a symbol that represents a class of values. By examining the tables of frequency for concentration values of the elements, we were able to divide the ranges of reported values for many elements into five classes so that approximately 20 percent of the values fell into each class. The limited range in values for some elements, however, prohibited the use of more than two or three classes to represent the total distribution. Symbols representing the classes were drawn on the maps by an automatic plotter that was guided by computer classification of the data, including the latitude and longitude of the sampling sites. A histogram on each map gives the frequency distribution of the analytical values, and the assignment of analytical values to each class as represented by symbols.

We were able to obtain analyses of 11 more elements for the 355 samples of phase two of this study than for the 963 samples of phase one because of improved analytical methods and services. These elements are antimony, bromine, carbon, germanium, iodine, rubidium, silicon, sulfur, thorium, tin, and uranium. The constraints of resources and time prohibited analysis of the 963 samples of the first phase for these additional elements. Results of analysis of the plant samples that were collected at all soil-sampling sites are not presented in this report.

Some elements were looked for in all samples but were not found. These elements, analyzed by the semiquantitative spectrographic method, and their approximate lower detection limits, in parts per million, are as follows: gold, 20; hafnium, 100; indium, 10; platinum, 30; palladium, 1; rhenium, 30; tantalum, 200; tellurium, 2,000; and thallium, 50. If lanthanum or cerium were found in a sample, the following elements, with their stated lower detection limits, were looked for in the same sample but were not found: dysprosium, 50; erbium, 50; gadolinium, 50; holmium, 20; lutetium, 30; terbium, 300; and thulium, 20.

DISCUSSION OF RESULTS

The data presented in this report may reveal evidence of regional variations in abundances of elements in soils or other regoliths; single values or small clusters of values on the maps may have little significance if considered alone. Apparent differences in values shown between certain sampling routes, such as some of those across the Great Plains and the North Central States where high values for cerium, cobalt, gallium, and lead predominate, suggest the possibility of systematic er-

rors in sampling or in laboratory analysis. Some gross patterns and some of lesser scale, nevertheless, are evident in the compositional variation of regoliths, as shown in figures 2-47.

The lower abundances of some elements (notably aluminum, barium, calcium, magnesium, potassium, sodium, and strontium) in regoliths of the Eastern United States, and the greater abundances of the heavy metals in the same materials of the Western United States indicate a regional pattern of the largest scale. This visual observation of the maps can be substantiated by examining the mean concentrations for these two regions given in table 2. The abundances of these elements differ markedly on either side of a line extending from western Minnesota southward through east-central Texas. This line is generally from the 96th to 97th meridian, and corresponds to the boundary proposed by Marbut (1935, p. 14), which divides soils of the United States into two major groups—the pedalfers that lie to the east, and the pedocals to the west. Marbut (1928) attributed the major differences in chemical and physical qualities of these two major groups to the effects of climate on soils. A line approximating the 96th meridian also separates the Orders, Suborders, and Great Groups of moist-to-wet soils in the Eastern United States from the same categories of dry soils that lie to the west, as mapped by the [U.S.] Soil Conservation Service (1969). As shown in table 2, soils of the Western United States have the highest mean values for all elements considered in this report except for antimony, boron, bromine, mercury, neodymium, selenium, titanium, and zirconium. The differences, however, probably are not significant for these latter elements, except for zirconium.

Superimposed upon this large-scale compositional variation pattern are several features of intermediate scale. Perhaps the most notable of these are the low concentrations of many elements in soils of the Atlantic Coastal Plain. Soils of the Pacific Northwest are high in concentrations of aluminum, cobalt, iron, scandium, and vanadium, but low in boron, and soils of the Rocky Mountain region tend to be high in copper, lead, and zinc.

Several small-scale patterns of compositional variation can be noted, among them the high mercury concentrations in surficial materials from the Gulf Coast of eastern Texas, Louisiana, Mississippi, Alabama, and northwest Florida, and a similar pattern on the Atlantic Coast in Connecticut, Massachusetts, and Maine. High phosphorus values occur in soils along a line extending west across Utah and Nevada to the coast of California, then south-east in California and Arizona. At the State level, Florida shows the most striking pattern by hav-

ing low soil concentrations of most of the elements considered in this study.

The concentrations of certain elements do not show well-defined patterns of distribution, and the regional concentrations of some other elements cannot be evaluated because they were not present in detectable amounts in most of the samples, or because the sampling density was insufficient. The degree of confidence in regional patterns of element abundance is expected to be in direct proportion to the number of samples analyzed from the region. As the observed patterns become smaller, the probability increases that the characteristics that form the patterns are the results of chance.

Some features of element-abundance patterns probably reflect geologic characteristics of the areas that the soils overlie. Samples from most of the regoliths overlying basic volcanic rocks of Washington and Oregon contained higher than average concentrations of iron and other elements, as mentioned earlier. A few soil samples with high phosphorus content are associated with phosphate deposits in Florida, and a single sample in Michigan with high copper content is known to be of soil that occurs over a copper deposit.

These data do not provide obvious evidences of north-south trends in elemental compositions that might be expected to relate to differences in temperature regimes under which the surficial materials developed. There is, moreover, no consistent evidence of significant differences in element abundances between glaciated and nonglaciated areas (the general area of continental glaciation includes the northern tier of States from Montana to Maine and south in places to about lat 40°N.; see fig. 1).

The world averages of abundance for some elements in soils, as given by Vinogradov (1959) and by others (table 1), do not correspond to the averages of abundance for these elements in the soils of the United States, according to the data presented in this report. The world averages are too low for the concentrations of boron, calcium, cerium, lead, magnesium, potassium, and sodium in United States soils and other surficial materials, and too high for beryllium, chromium, gallium, manganese, nickel, phosphorus, titanium, vanadium, and yttrium.

The stability of values for concentrations of most elements seems to be satisfactory because the addition of analytical values for 355 samples of phase two of the study to values for 963 samples of the first phase did not significantly change the geometric means and deviations of element abundance that were reported earlier (Shacklette, Boerngen, and Turner, 1971; Shacklette, Hamilton, and others, 1971; Shacklette and others,

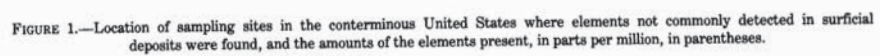
1973, 1974). Although additional sampling of the same type as reported here might give a clearer picture of small-to-intermediate element-abundance patterns, mean values reported herein most likely would not change significantly.

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ILLUSTRATIONS



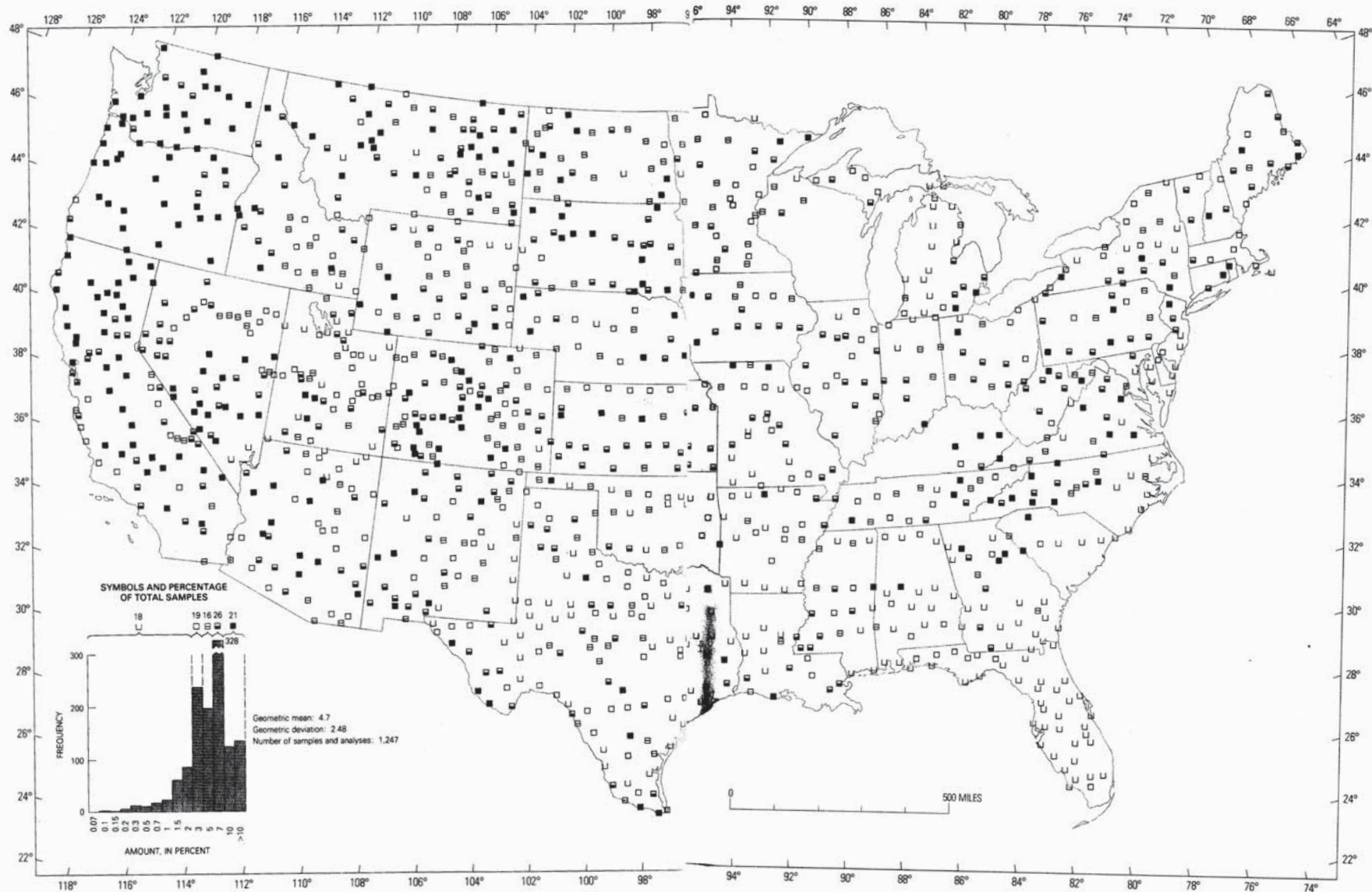


FIGURE 2.—Aluminum content of surficial materials.

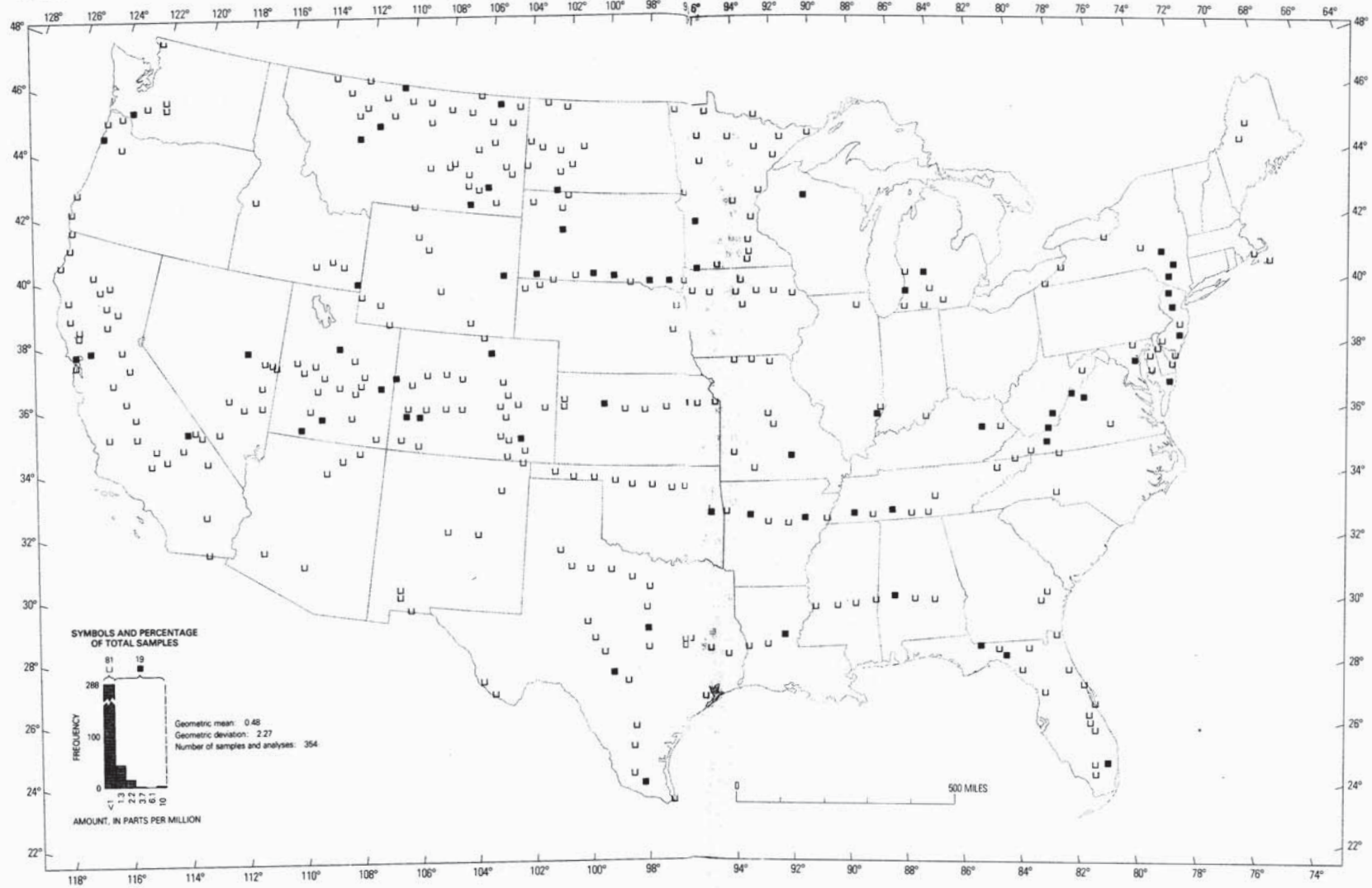


FIGURE 3.—Antimony content of surficial materials.



FIGURE 4.—Arsenic content of surficial materials.

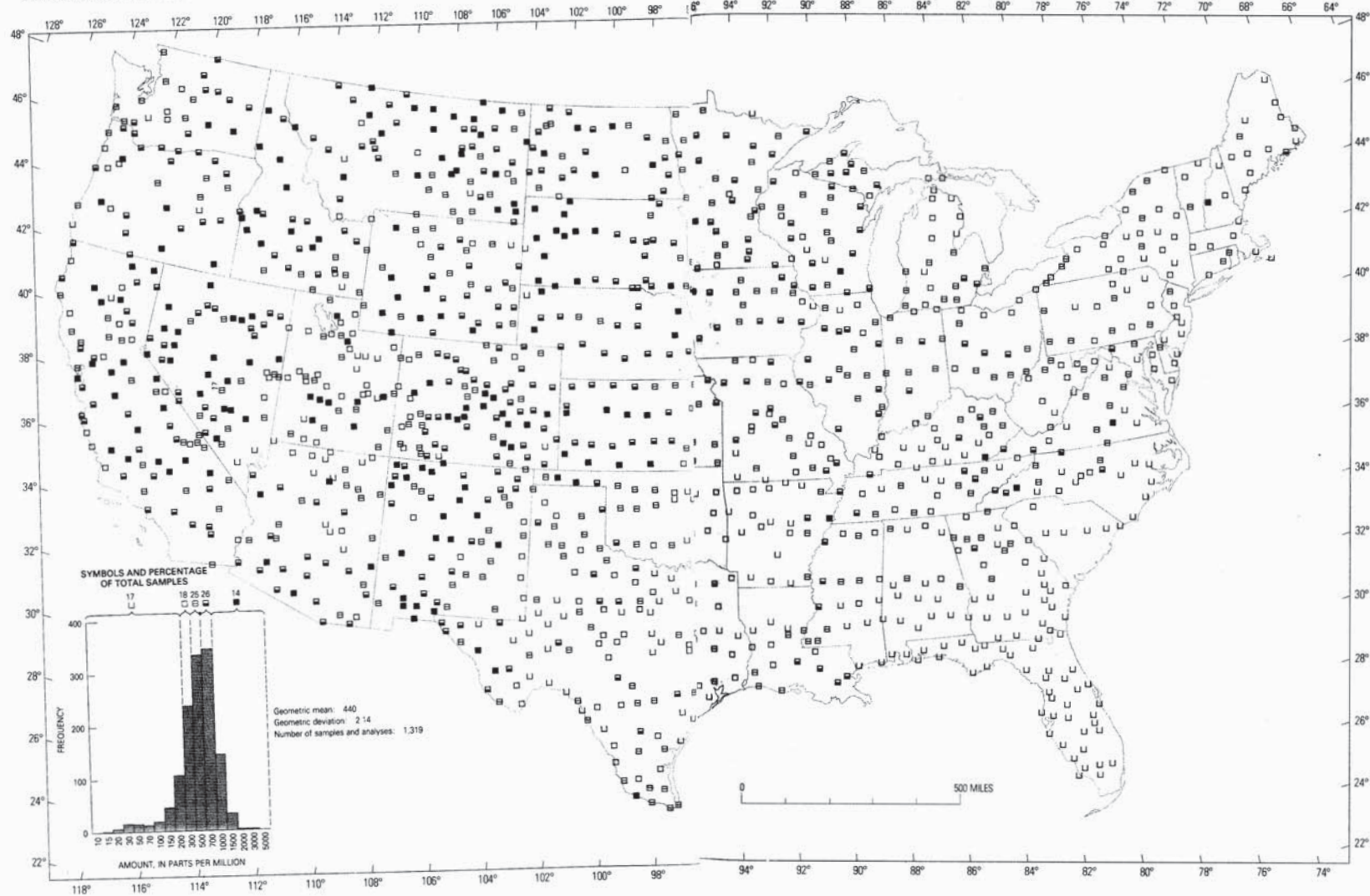


FIGURE 5.—Barium content of surficial materials.

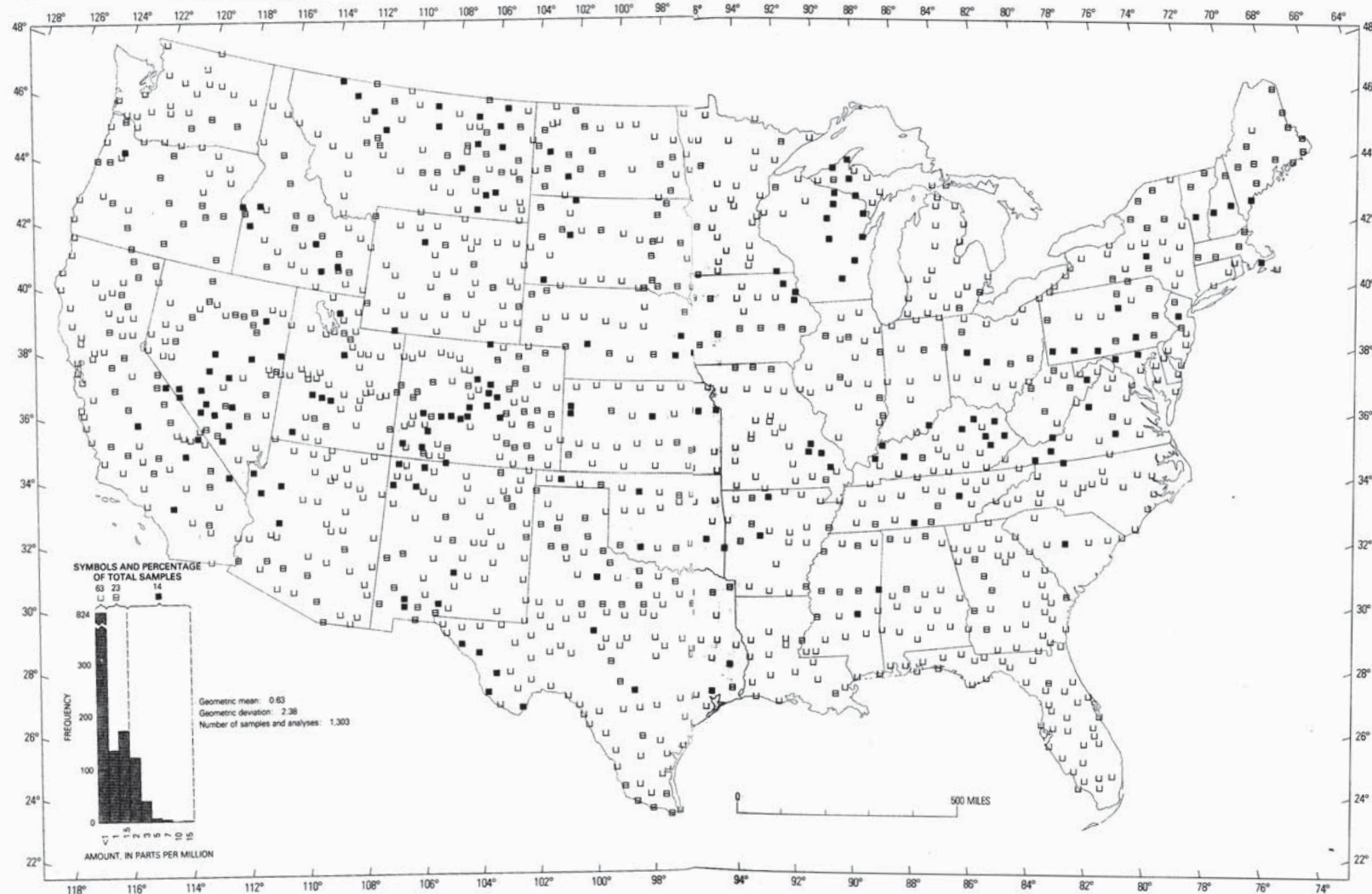


FIGURE 6.—Beryllium content of surficial materials.

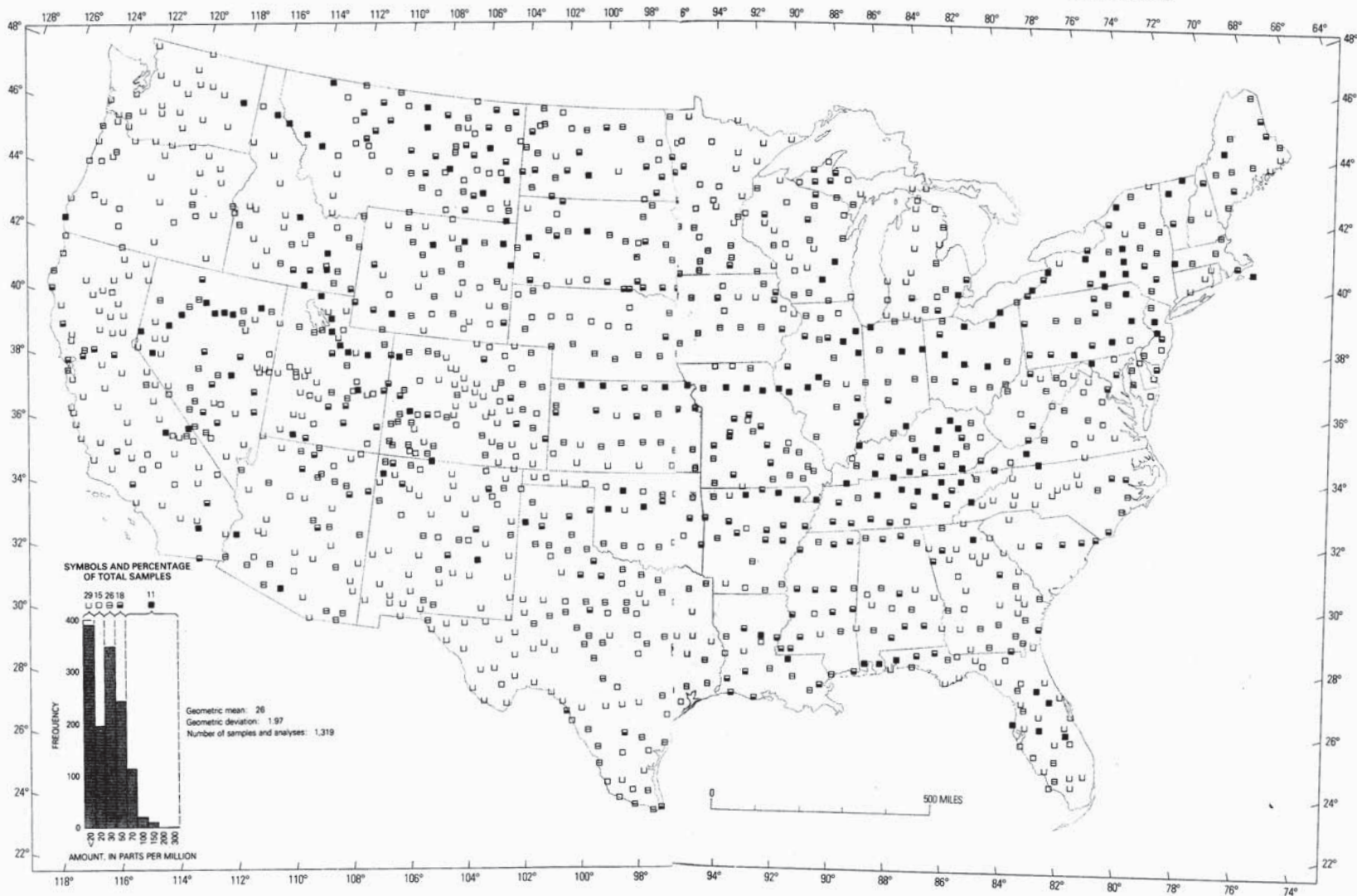


FIGURE 7.—Boron content of surficial materials.

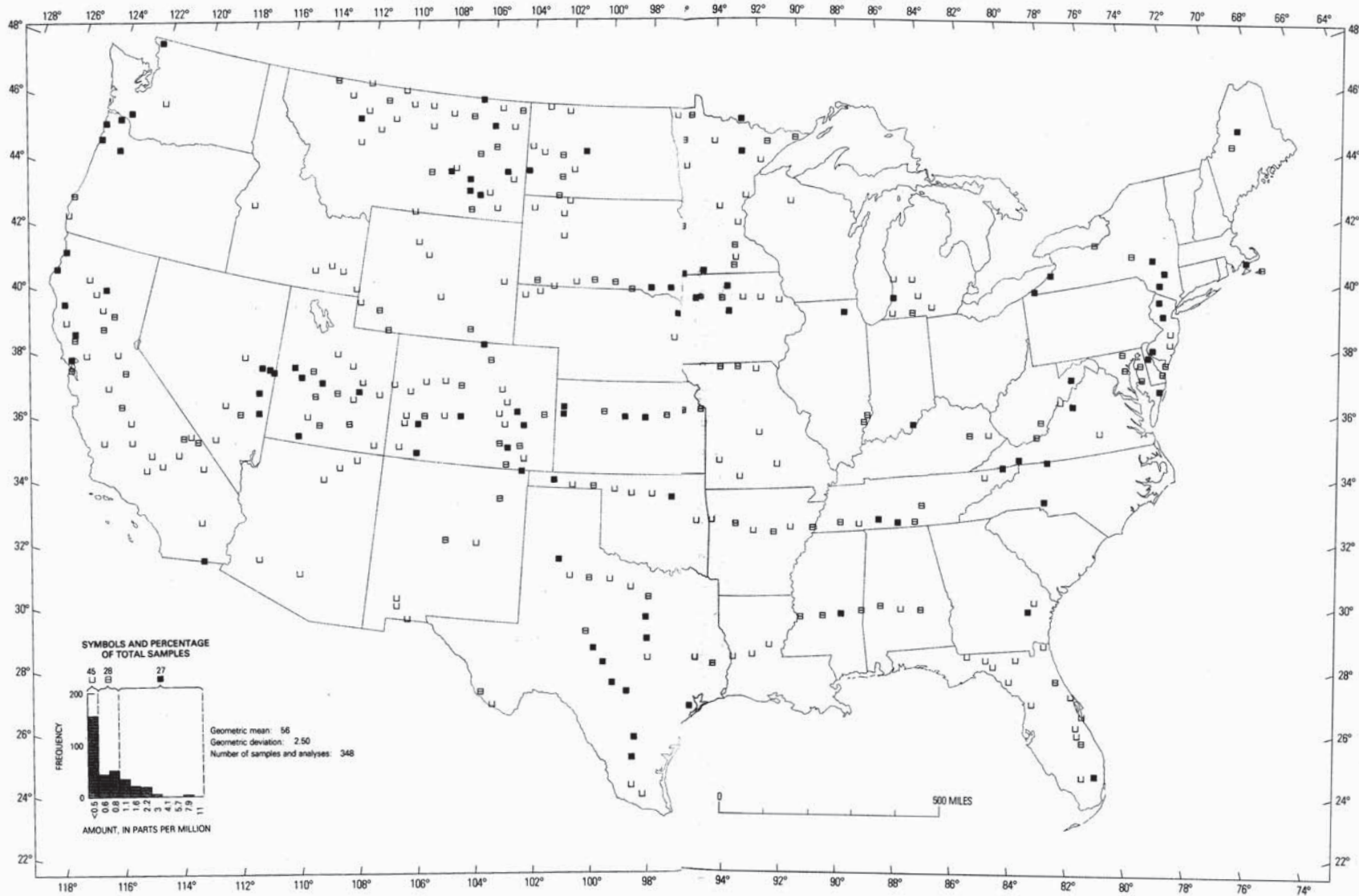


FIGURE 8.—Bromine content of surficial materials.

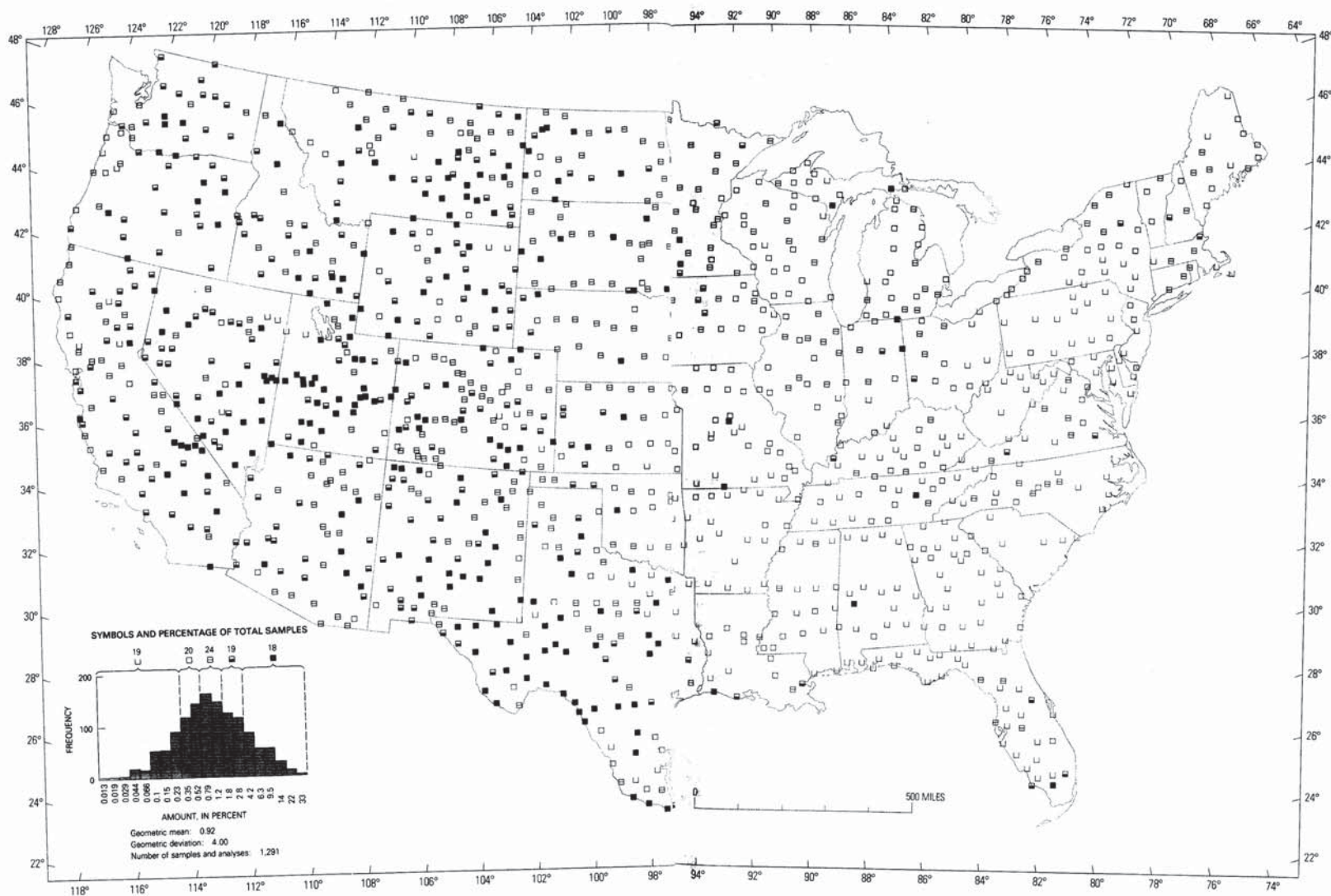


FIGURE 9.—Calcium content of surficial materials.



FIGURE 10.—Carbon (total) content of surficial materials.

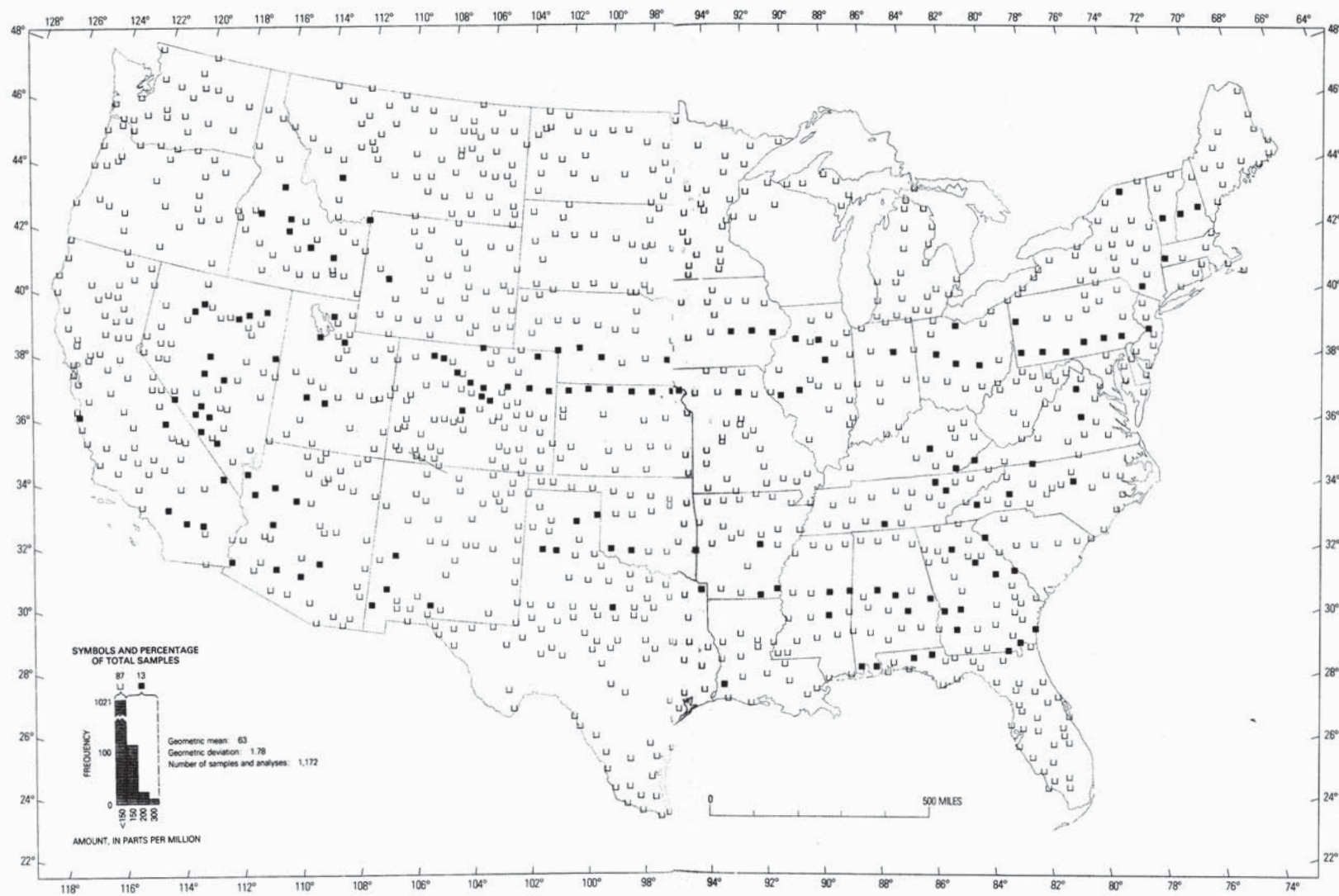


FIGURE 11.—Cerium content of surficial materials.

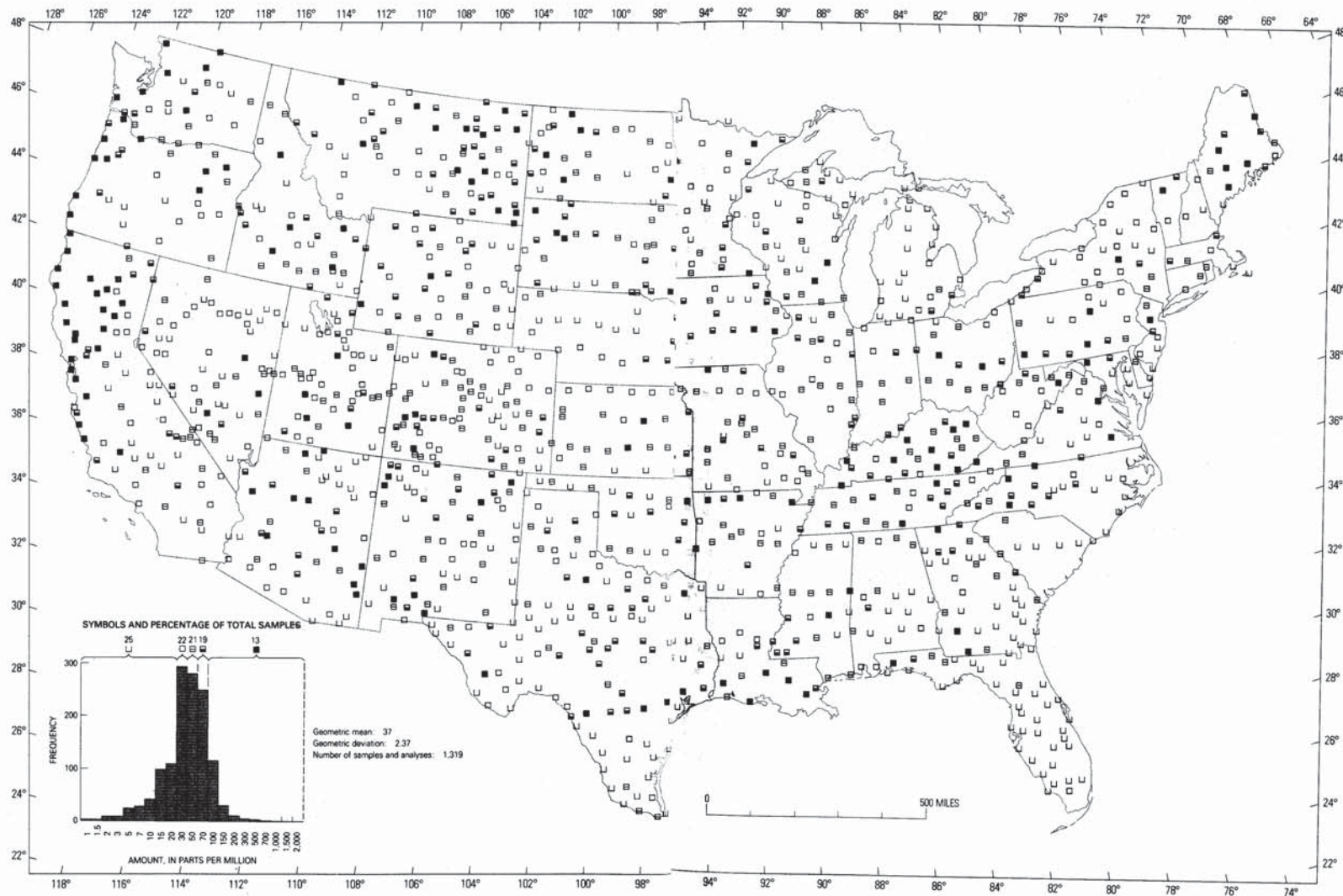


FIGURE 12.—Chromium content of surficial materials.

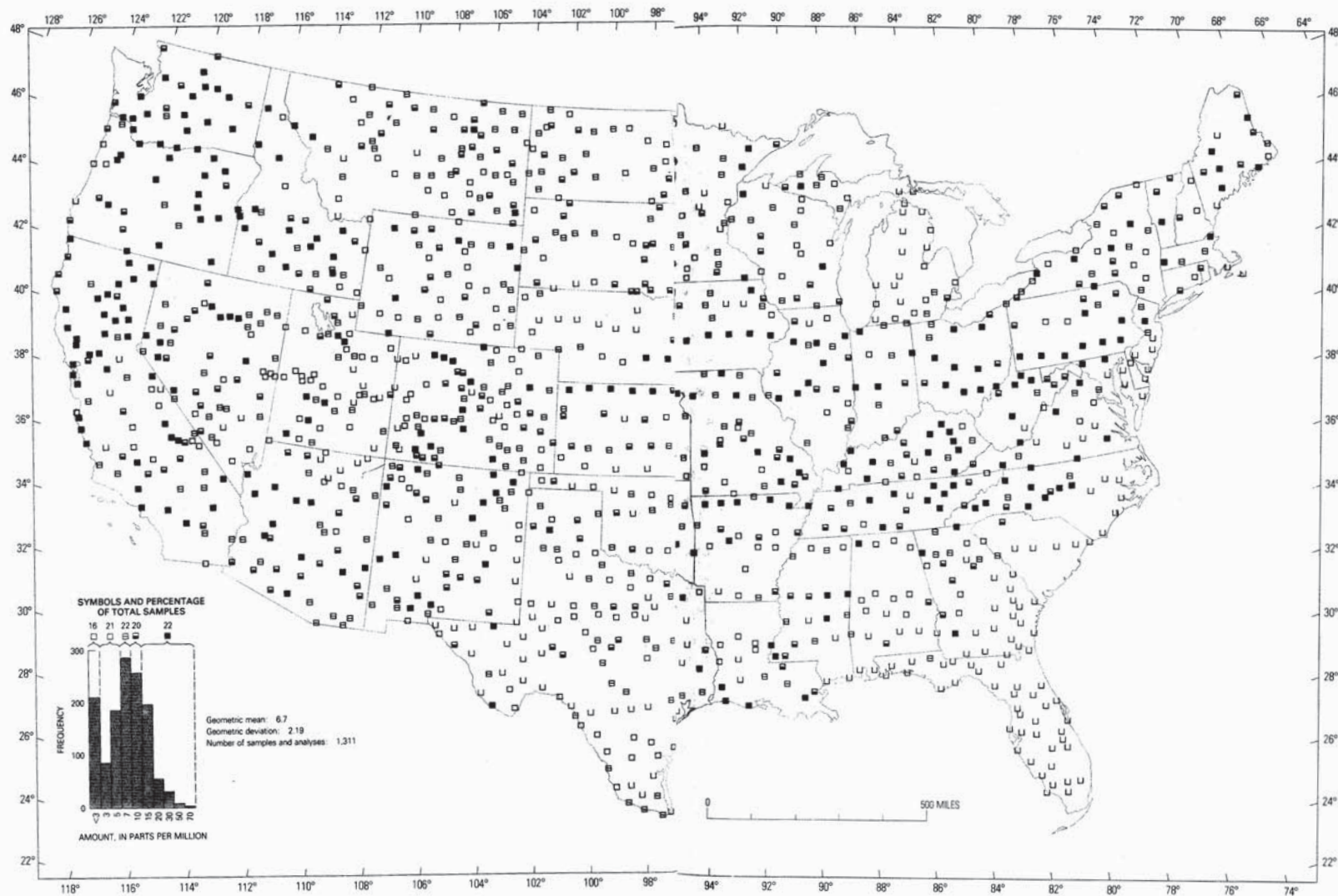


FIGURE 13.—Cobalt content of surficial materials.

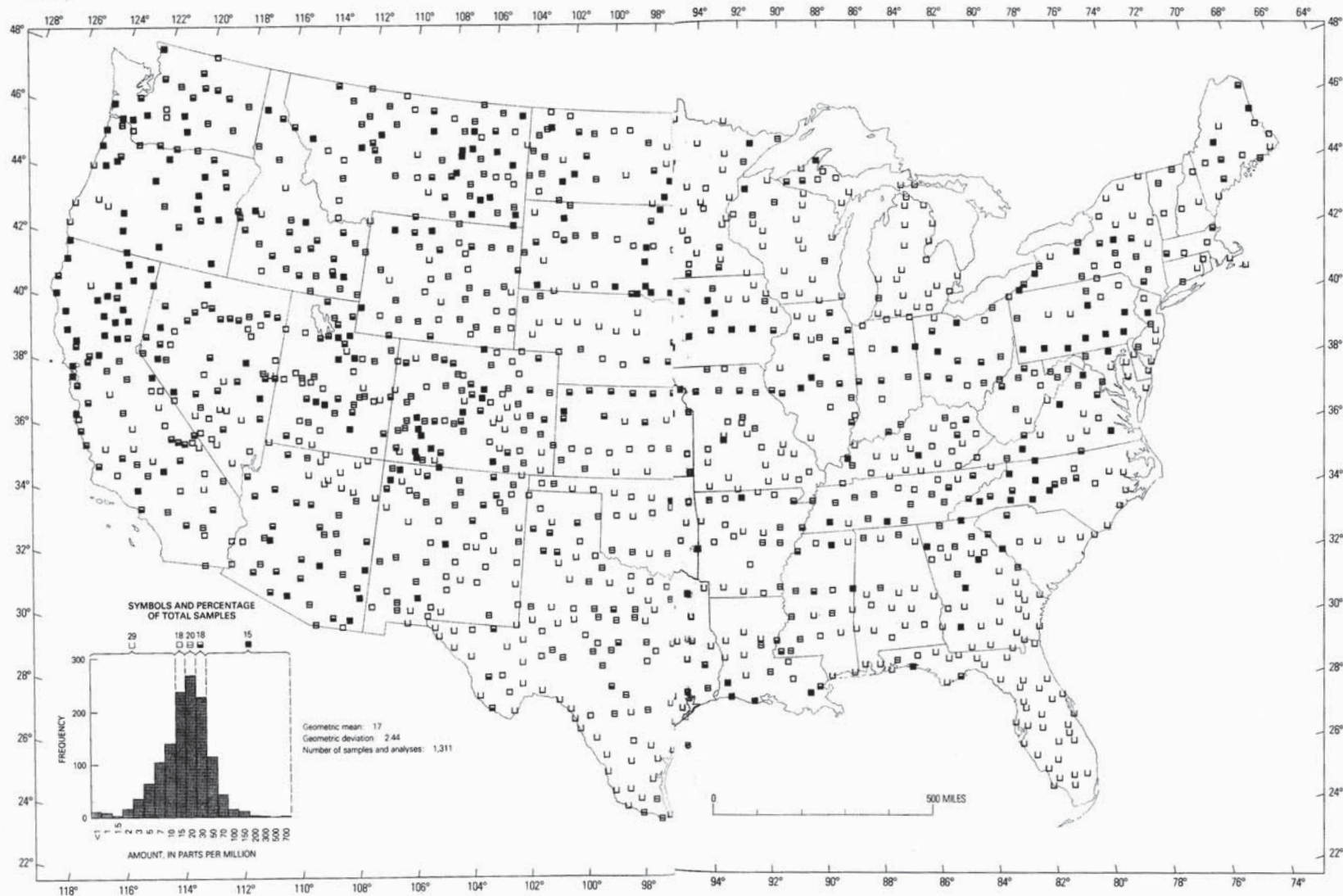


FIGURE 14.—Copper content of surficial materials.

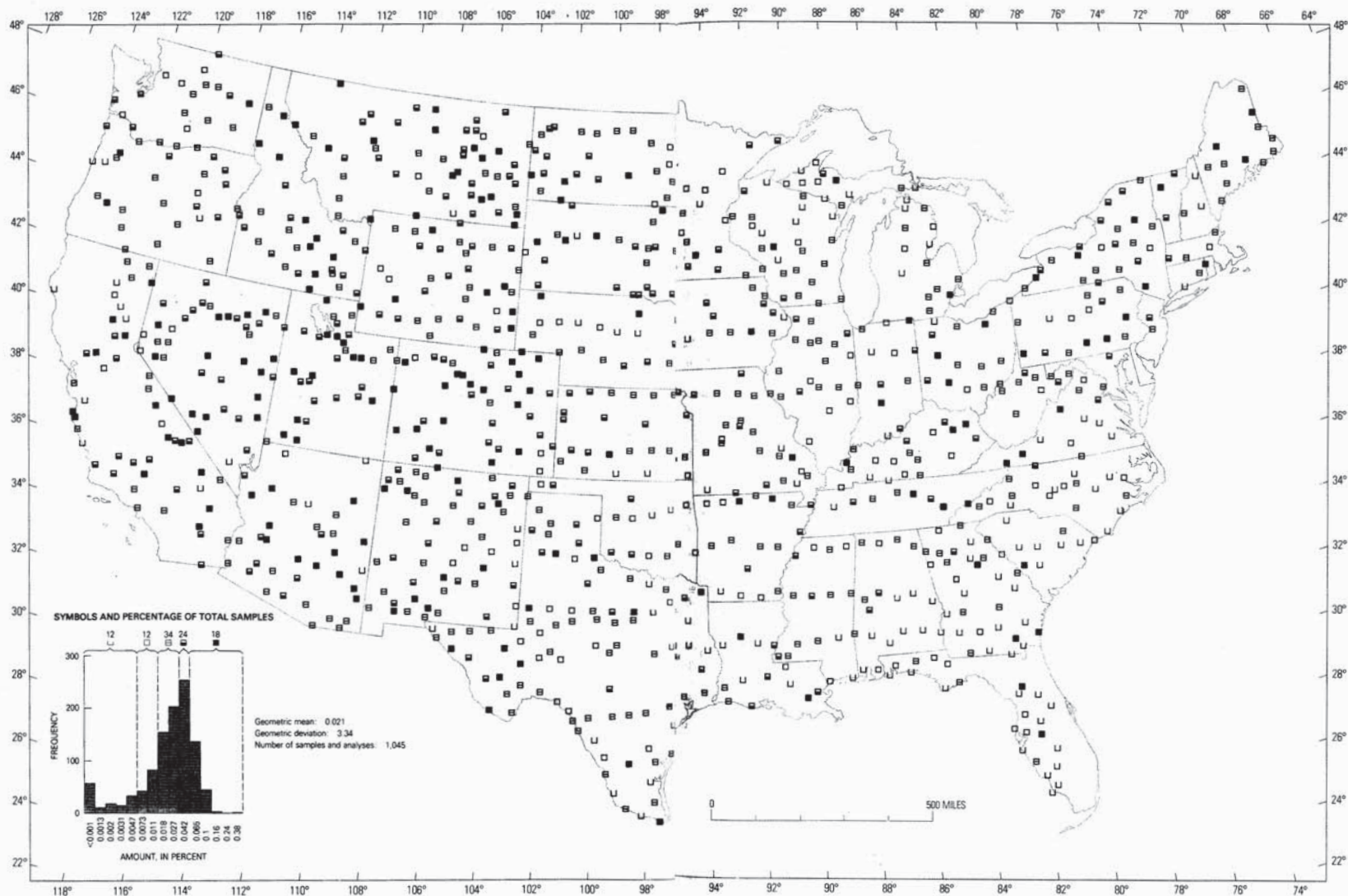


FIGURE 15.—Fluorine content of surficial materials.



FIGURE 16.—Gallium content of surficial materials.



FIGURE 17.—Germanium content of surficial materials.



FIGURE 18.—Iodine content of surficial materials.



FIGURE 19.—Iron content of surficial materials.



FIGURE 20.—Lanthanum content of surficial materials.



FIGURE 21.—Lead content of surficial materials.



FIGURE 22.—Lithium content of surficial materials.

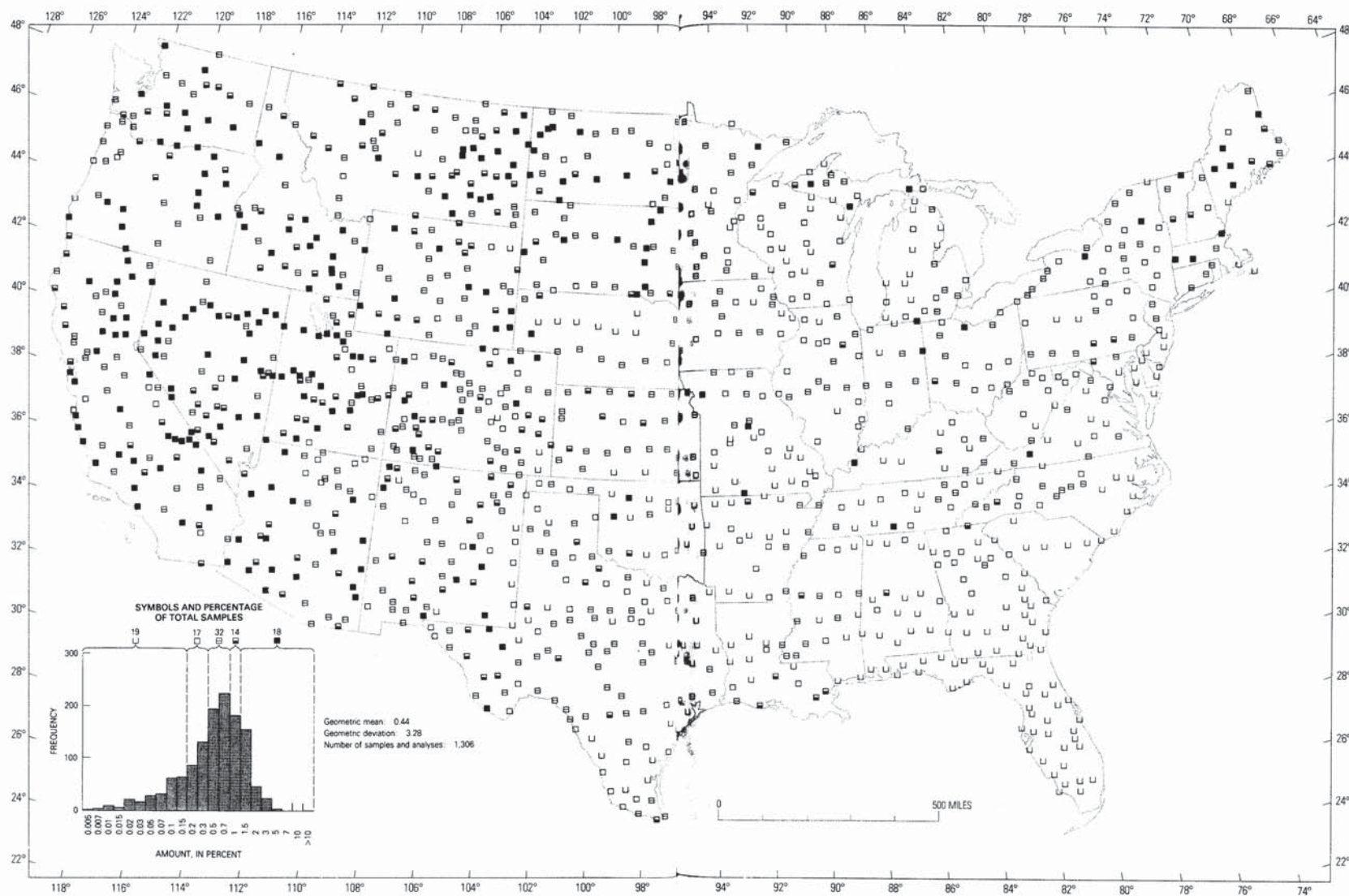


FIGURE 23.—Magnesium content of surficial materials.



FIGURE 24.—Manganese content of surficial materials.

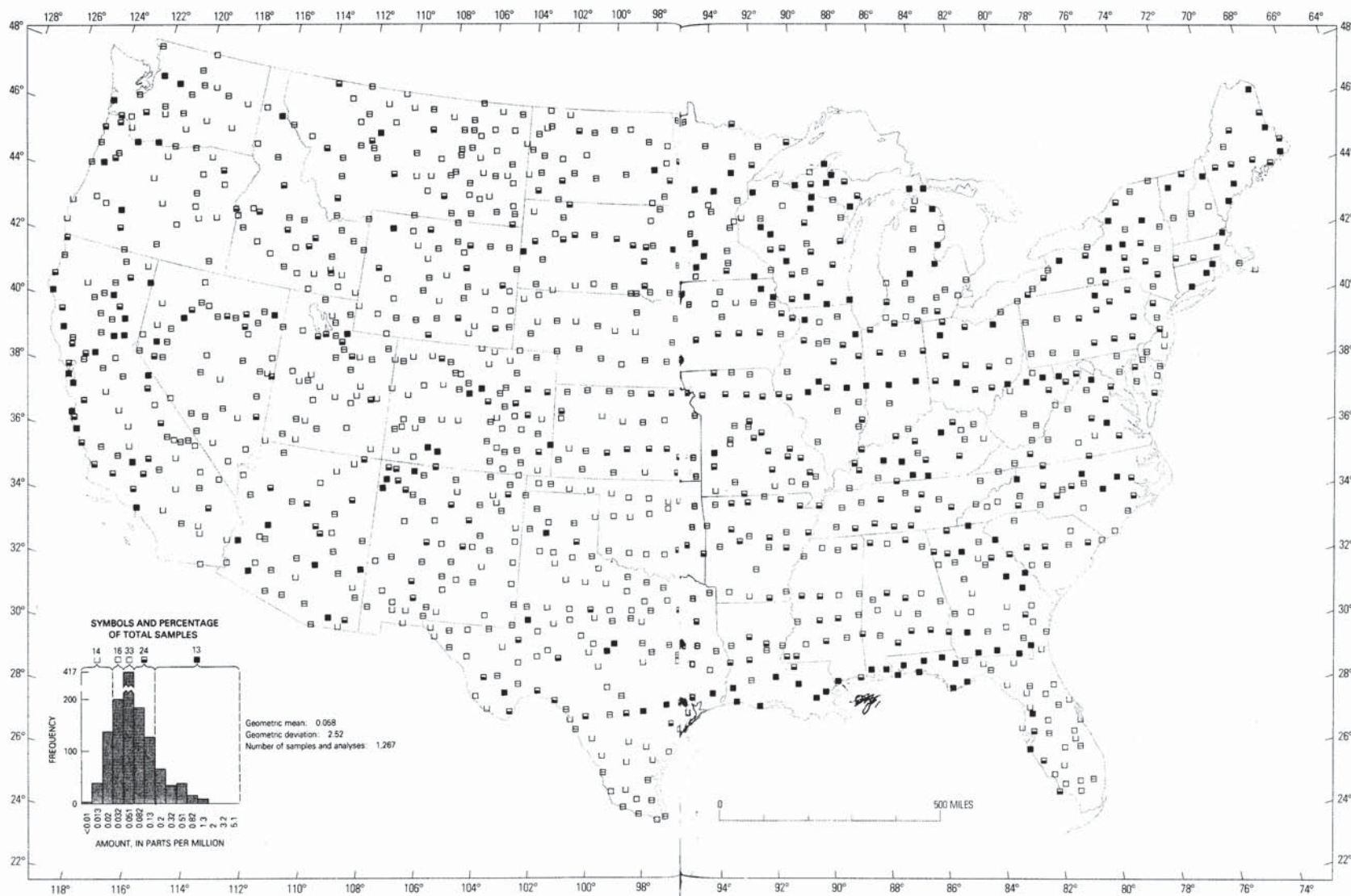


FIGURE 25.—Mercury content of surficial materials.

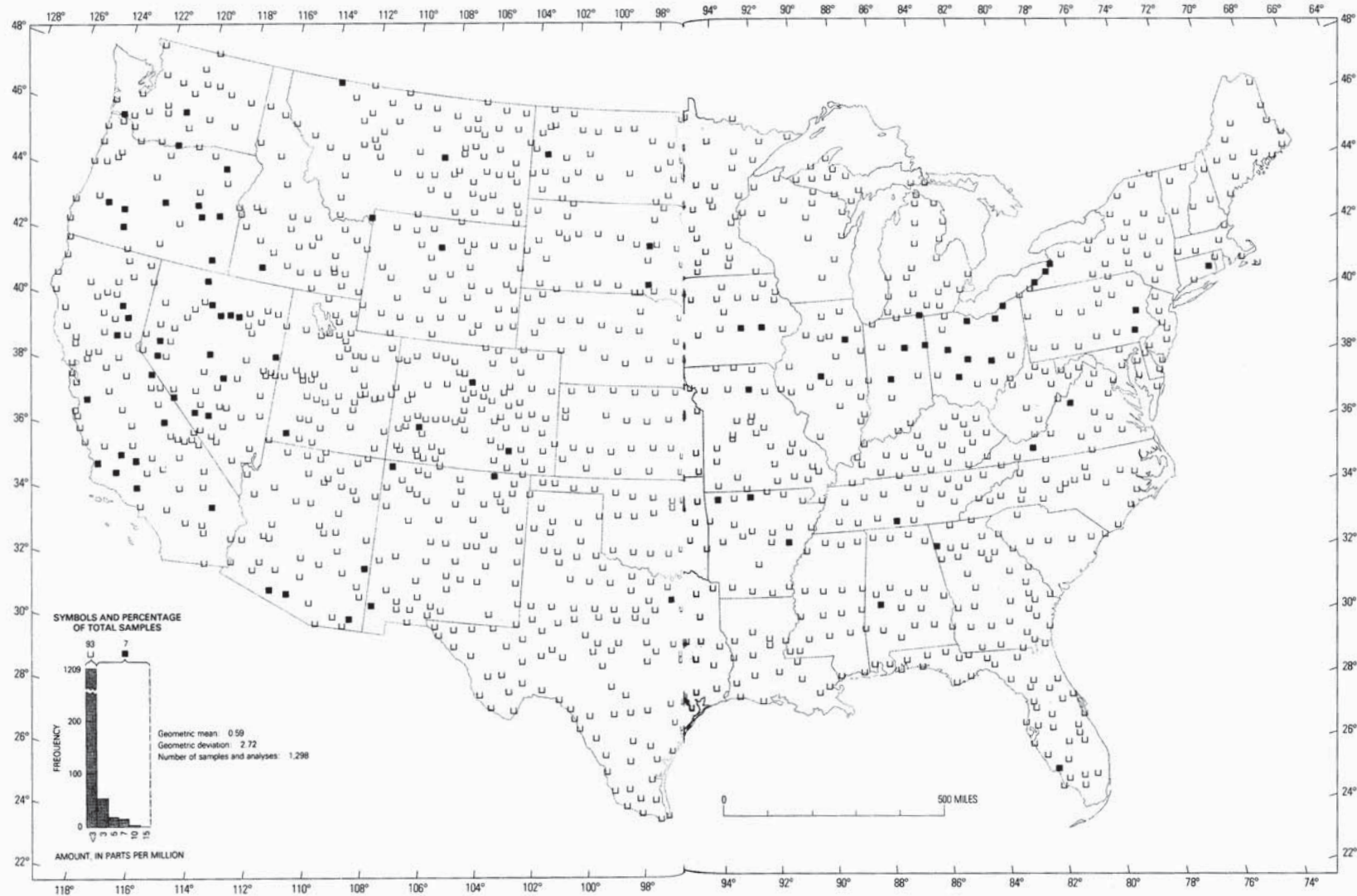


FIGURE 26.—Molybdenum content of surficial materials.



FIGURE 27.—Neodymium content of surficial materials.



FIGURE 28.—Nickel content of surficial materials.

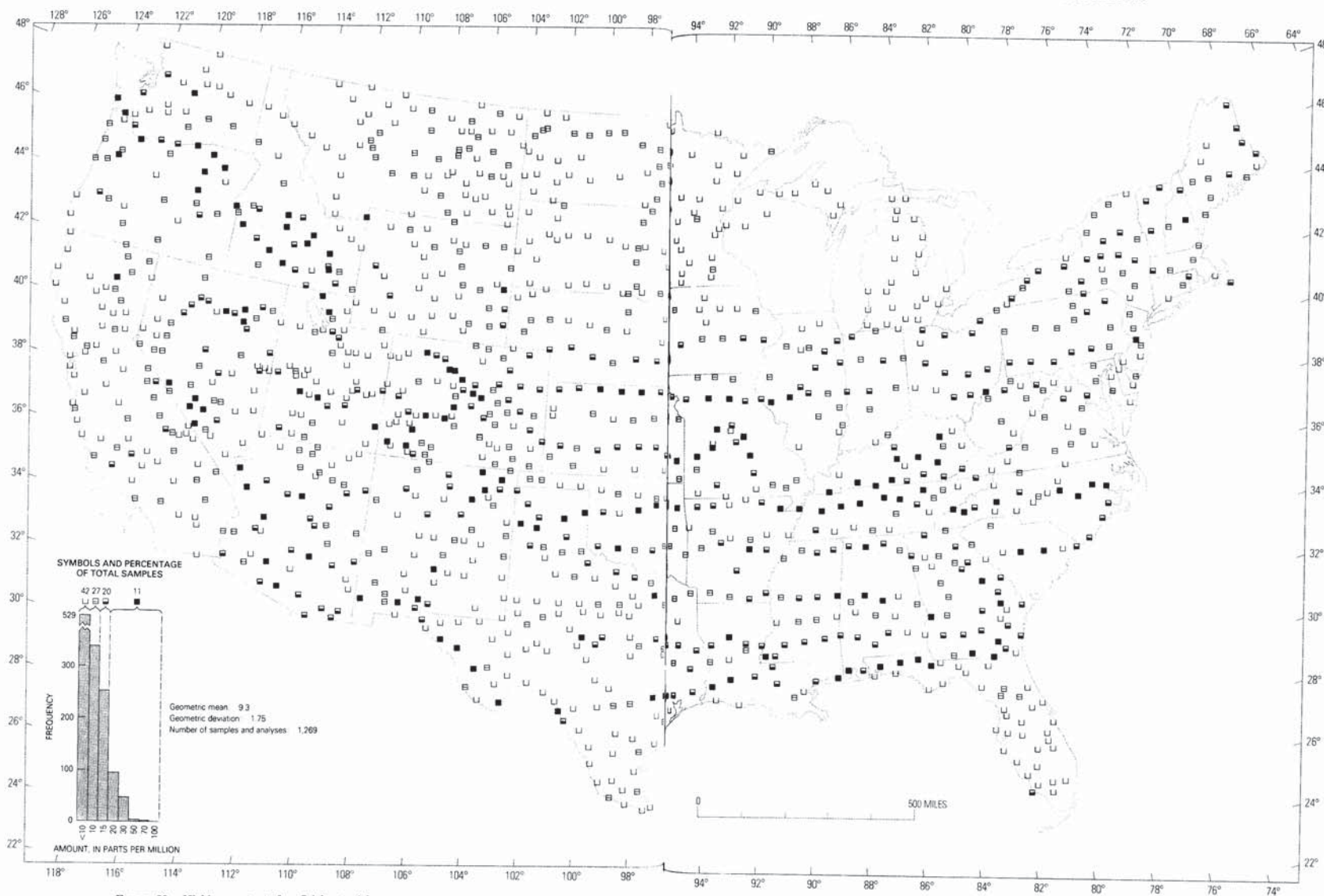


FIGURE 29.—Niobium content of surficial materials.

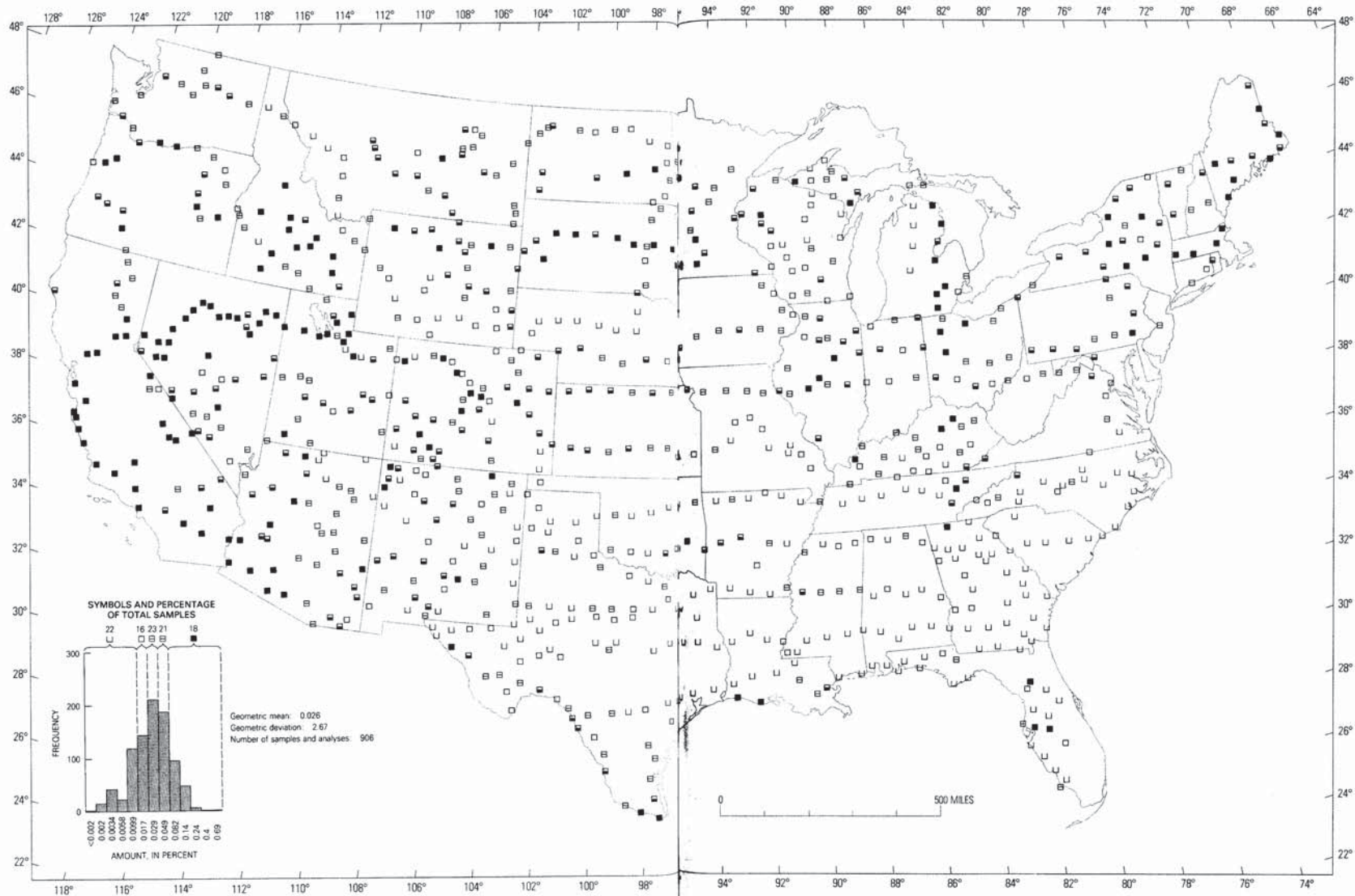


FIGURE 30.—Phosphorus content of surficial materials.



FIGURE 31.—Potassium content of surficial materials.

ELEMENT CONCENTRATIONS IN SOILS, CONTERMINOUS UNITED STATES

ILLUSTRATIONS

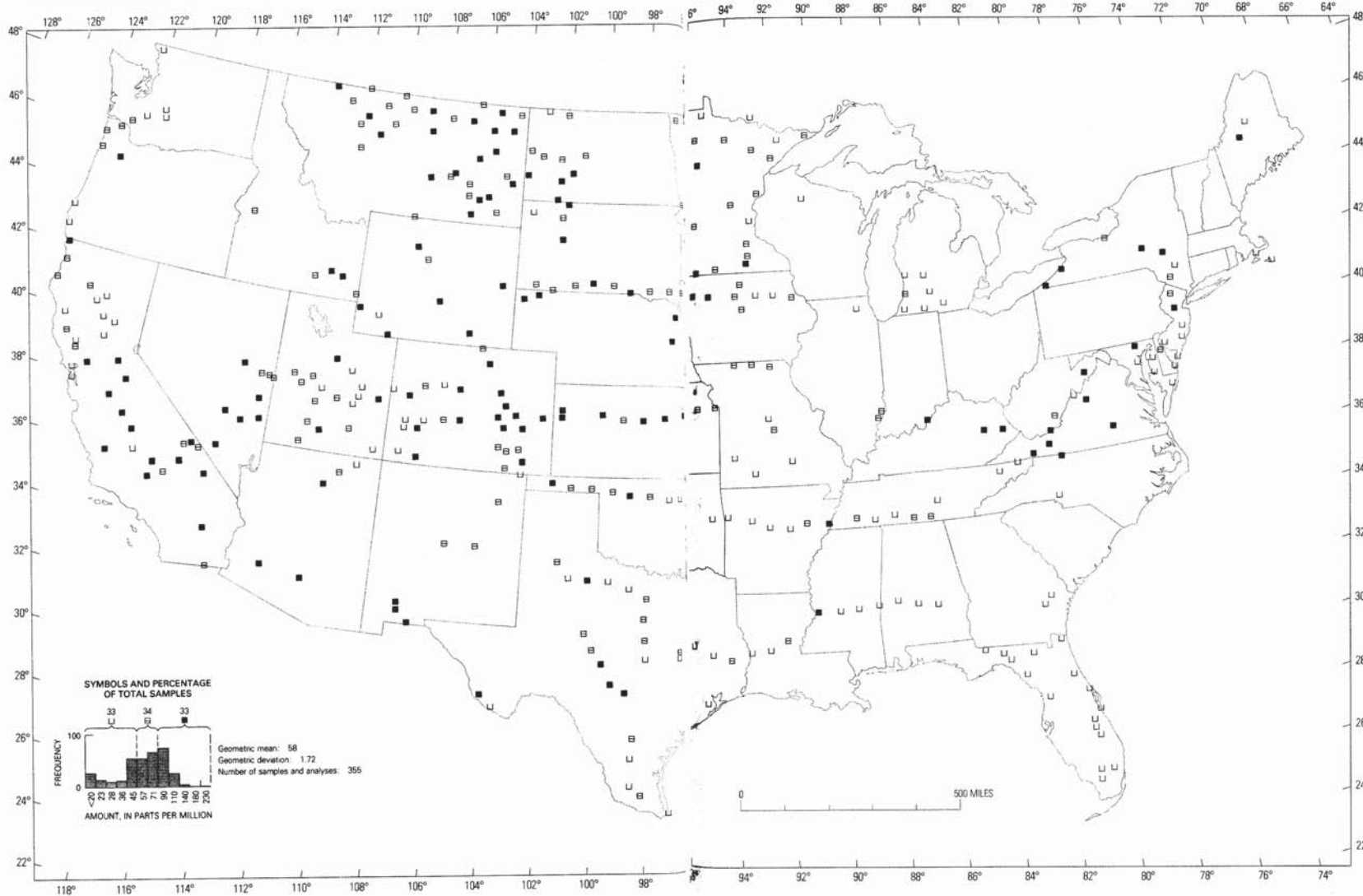


FIGURE 32.—Rubidium content of surficial materials.



FIGURE 33.—Scandium content of surficial materials.



FIGURE 34.—Selenium content of surficial materials.

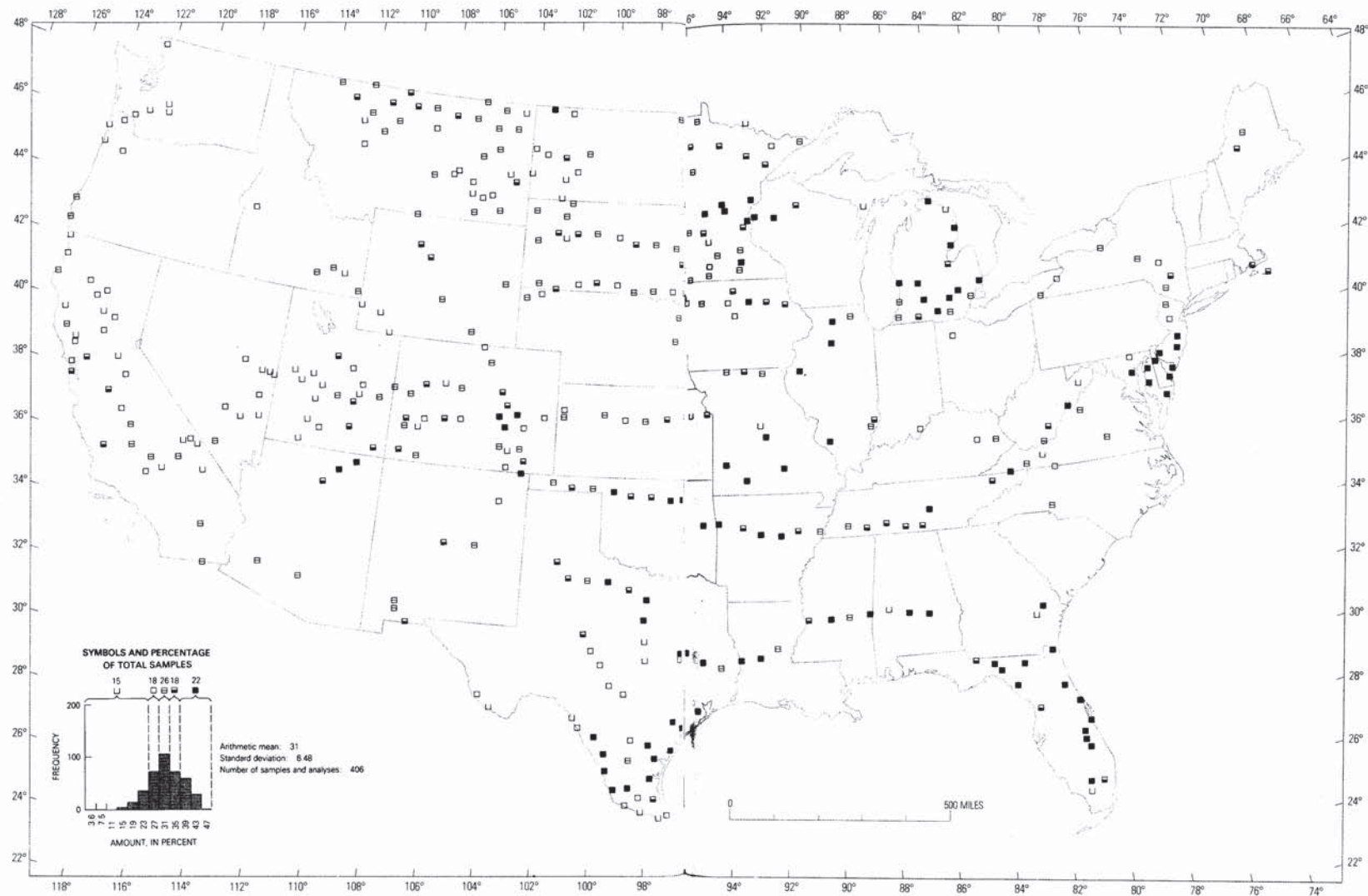


FIGURE 35.—Silicon content of surficial materials.



FIGURE 36.—Sodium content of surficial materials.



FIGURE 37.—Strontium content of surficial materials.



FIGURE 38.—Sulfur content of surficial materials.



FIGURE 39.—Thorium content of surficial materials.



FIGURE 40.—Tin content of surficial materials.



FIGURE 41.—Titanium content of surficial materials.



FIGURE 42.—Uranium content of surficial materials.

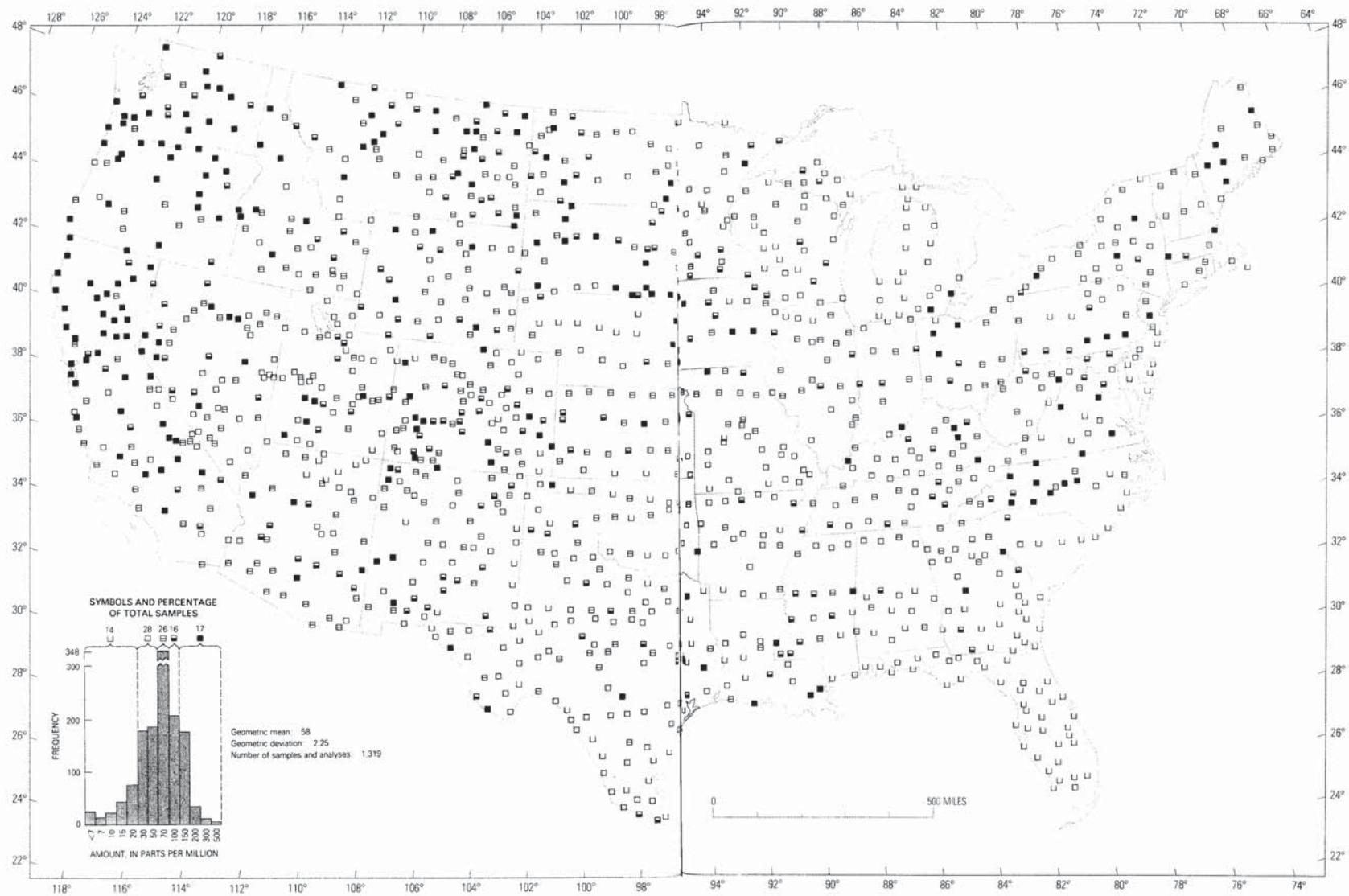


FIGURE 43.—Vanadium content of surficial materials.



FIGURE 44.—Ytterbium content of surficial materials.



FIGURE 45.—Yttrium content of surficial materials.



FIGURE 46.—Zinc content of surficial materials.

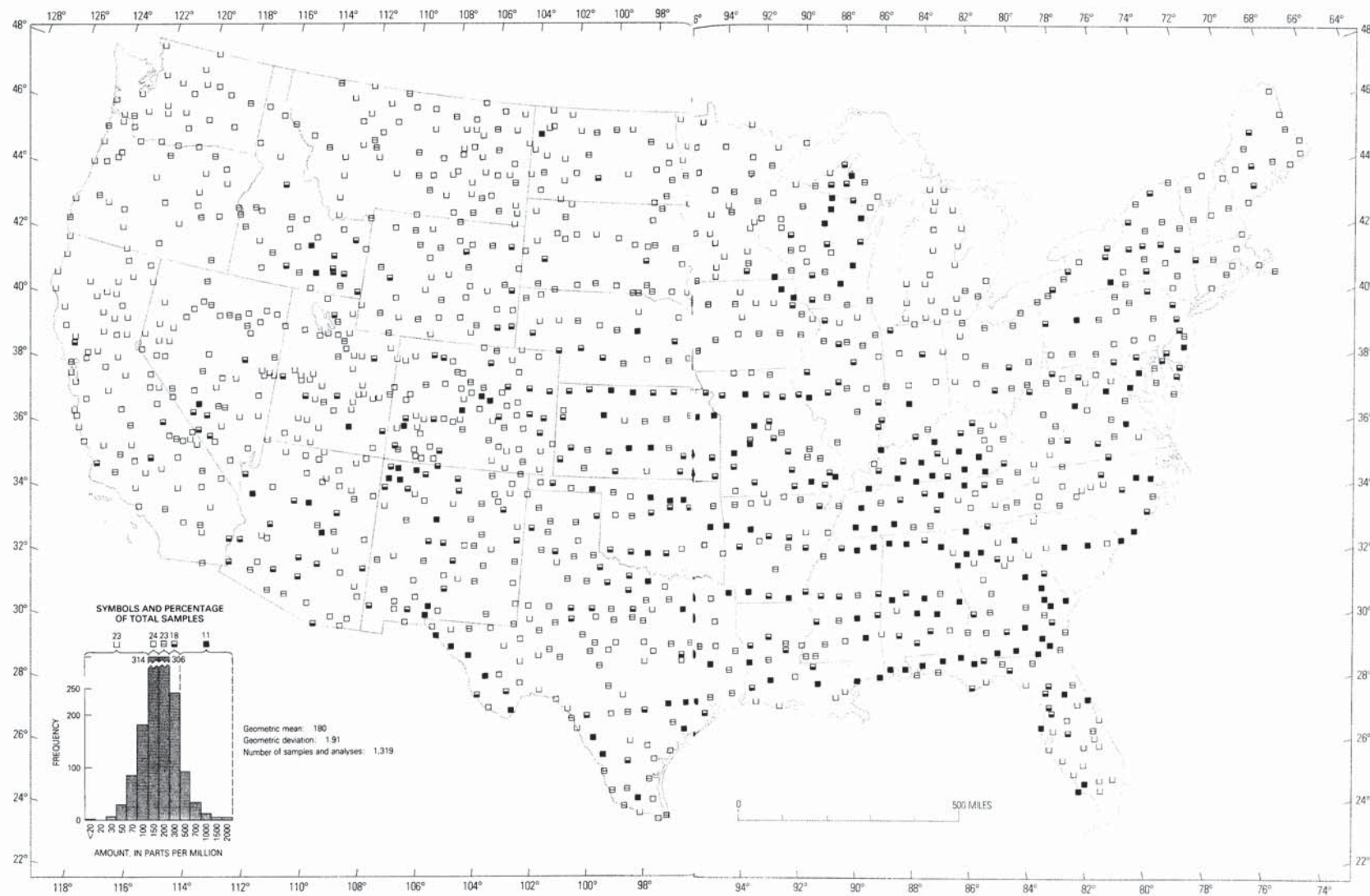


FIGURE 47.—Zirconium content of surficial materials.